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THESIS

**PERFORMANCE MEASURE ANALYSIS OF COMMAND
AND CONTROL ORGANIZATIONAL AND TASK
STRUCTURES**

by

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September 1996

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PERFORMANCE MEASURE ANALYSIS OF COMMAND AND CONTROL
ORGANIZATIONAL AND TASK STRUCTURES

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ABSTRACT

Recent joint operations such as the ones in the Persian Gulf, Somalia, Haiti, and Bosnia are examples of some of the missions the military is expected to conduct in the future. The missions and available forces varied, and not surprisingly, so did the command and control architectures.

The purpose of the initial A2C2 experiment was to examine the relationships between organizational structures and task structures involving competition for scarce assets, to serve as an integration vehicle for the project's previous efforts, and as a baseline for further research. This thesis attempts to answer the following questions: 1) "Are there statistically significant differences in the outcomes of competition events based on the particular experimental conditions imposed?" and 2) "Is there a viable method for determining the processes involved in the resolution of competition events, and can it be accomplished without the use of human monitors, i.e., can a tool be developed to determine the processes used in the resolution of competition events after an experiment is conducted?"

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EXECUTIVE SUMMARY

Recent joint operations such as the ones in the Persian Gulf, Somalia, Haiti, and Bosnia are typical examples of some of the varied types of missions the military is expected to conduct in the future. In each case, the CJTF was presented with a mission and a mix of forces, including multinational assets. The missions varied, the available forces varied, and not surprisingly, so did the command and control architectures of the JTFs. In many instances, the structure of the C2 architecture changed during the operation. What signaled the need for change, what changed, and how the change was accomplished are very salient questions. The A2C2 researchers have conducted structured, scenario driven interviews with current flag and general officers to try and gain insight into what may cause adaptation in organizations. The results of these interviews were incorporated into this first experiment, providing the basis for the experimental scenarios and conditions. One common belief was that the emerging common operational picture will allow "flatter" architectures. Lower level commanders will be able to compare the current situation to the commander's intent and act accordingly, with less guidance; and thus higher level commanders will be able to increase their span of control.

The purpose of this experiment was to examine the relationships between command and control architectures and different types of tasks that involve competition for scarce assets. A common operational picture of a joint area of operations was presented to participants using the Distributed Dynamic Decisionmaking III (DDD-III) simulator. By varying organization and task structures, the DDD-III was used to gain

insights into the outcomes of specific competition events and the processes used to arrive at those outcomes.

The first A2C2 experiment was designed as an integration vehicle for the projects' efforts thus far, and as a baseline for further research. There were a vast number of research issues, motivated by initial field research. This initial experiment addresses the question; "...can tasks differ in coordination requirements in such a way that an organization structure with more layers is better for some tasks, while a structure with fewer layers is better for others?" (Kemple, Kleinman, Berigan, 1996)

Questions specific to this thesis are:

1. Are there statistically significant differences in the outcomes of competition events based on the particular experimental conditions imposed?
2. Is there a viable method for determining the processes involved in the resolution of competition events, and can it be accomplished without the use of experimental observers, i.e., can a tool be developed to determine the processes used in the resolution of competition events (or any events) after an experiment is conducted?

The answer to both questions is "yes"; although in the case of the first question, a qualified yes. Programs that the author developed to satisfy the second question are included.

I. INTRODUCTION

A. BACKGROUND

“Joint warfare is team warfare.”

Two major events occurred in recent years that caused tumultuous changes in the United States military. 1.) The Goldwater-Nichols Act of 1986 mandated that all services become “joint.” 2.) The fall of the Soviet Union in 1989 left the United States military without a primary enemy and associated mission. These two events had serious implications in their own right, but taken together were extremely hard for the Department of Defense to come to terms with. Paradigms shifted, thought processes changed, and “boxes” no longer had the same boundaries.

The end of the Cold War and the Persian Gulf War in 1991 signaled the need for a major shift of focus for the Navy. No longer was the primary enemy the Soviet Union, whose military could challenge that of the United States on a global scale, and whose Navy would have to be defeated in the open ocean by Naval forces, but small, yet powerful regional regimes. Most of these regimes were located in the littoral, or coastal regions of the world where they would have to be defeated by joint forces. The white papers “...From the Sea” and “Forward...From the Sea” dealt with this by focusing Naval power more on the littoral regions of the world, while still maintaining a strong “blue water” capability. This shift in focus, taken with the emergence of regional powers with more sophisticated weaponry and the emergence of joint warfare, forced the Navy, in concert with the Marine Corps, to re-examine their approach to several new or different primary mission areas. These included Major Regional Conflicts (MRCs), Lesser

Regional Conflicts (LRCs), Theater Ballistic Missile Defense (TBMD), Peacekeeping missions, and Low Intensity Conflicts (LIC). Though extremely capable with respect to performing the old Maritime Strategy, the Navy quickly learned that there were problems when it came to dealing with these other missions. The Navy had always trained with the Marine Corps for missions similar to those listed above, but their emergence as primary mission areas under the purview of a joint task force presented difficulties with interoperability that until that time were not given a great amount of attention.

The Goldwater-Nichols Act required the services to change the way they thought, bought, and acted towards each other. The Navy-Marine Corps team was forced to re-think its relationships with the Army and the Air Force, and the Air Force and Army had to do the same. Goldwater-Nichols not only mandated that the services begin to consider jointness in procurement, but to also consider their actual working relationships in a joint task force (JTF). This raised the specter of command and control interoperability. Now the services had to understand the command and control architecture and equipment of all of the other services.

This transition was made easier by joint publications which set forth doctrine for operating in a JTF environment. "Doctrine represents the fundamental principles that guide the employment of forces," and "deals with the fundamental issue of how best to employ the national military power to achieve strategic ends." (Joint Pub 1) These joint publications cover the spectrum of conflict, from simple presence missions to full-scale war. The doctrine set forth in the joint publications gives specific guidance regarding command and control architecture for a large number of different missions, but gives little

guidance for situations that are different than those published. It is left up to the Commander, Joint Task Force (CJTF) to develop and implement any changes that are necessary for a particular mission.

One of the major problems encountered was that Cold War command and control (C2) structures were no longer sufficient or efficient for the post-Cold War era. The number and variety of missions assigned to the military was staggering, yet force downsizing was taking place, and the requirement emerged for most operations to be "joint." Command and control became a very daunting issue. Of particular interest was how to form a joint organization that could effectively handle many diverse missions that change in scope and degree with time. "To achieve superior performance and maintain a common picture of the battlefield, C3 [Command, Control, and Communication] organizations must be able to adapt their architecture – C2 processes as well as structures – in response to changes in the mission and the demands of the environment." (Serfaty, 1996)

The Office of Naval Research (ONR) has sponsored a four year project to examine joint command and control issues, particularly those dealing with "the underlying processes of organizational changes and architectural adaptations that occur in Joint C2 organizations." (Serfaty, 1996) This project, titled *Adaptive Architectures for Command and Control* (A2C2), is a follow-on to twelve years of Navy decision-making research. Participants include: Alphatec, Inc., Aptima, Inc., The Mitre Corporation, Sonalysts, Inc., The University of Connecticut, George Mason University, Carnegie-Mellon University, Michigan State University, The Naval Postgraduate School, and the Office of Naval

Research. This research effort is driven by the need for warfighters to know how and when to change their organizational structure and the way they conduct operations and to form organizations that facilitate this adaptation. It is guided by the requirement for joint operations in most situations, including those dealing with Operations Other Than War (OOTW). The A2C2 researchers recognized the shift of focus from the blue water, service-oriented mentality to the littoral, joint mentality. They are using this shift to “drive the design of scenarios and the development of experimental testbeds proposed for this new effort.” (Serfaty) This effort is a “careful progression of models, theory-based hypotheses, baseline experiments [tier 1], applied experiments [tier 2], and advanced technology demonstrations [tier 3].” (Serfaty, 1996) The first tier-1 (controllable, laboratory based) experiment of this research effort was conducted in March 1996 at the Naval Postgraduate School. This thesis reports on this experiment, which was designed “to integrate the project’s efforts, and serve as a baseline for future research.” (Kemple, Hutchins, Kleinman, Sengupta, Berigan, Smith, 1996)

B. PURPOSE

1. A2C2 Baseline Experiment

Recent joint operations such as the ones in the Persian Gulf, Somalia, Haiti, and Bosnia are typical examples of some of the varied types of missions the military is expected to conduct in the future. In each case, the CJTF was presented with a mission and a mix of forces, including multinational assets. The missions varied, the available forces varied, and not surprisingly, so did the command and control architectures of the JTFs. In many instances, the structure of the C2 architecture changed during the

operation. What signaled the need for change, what changed, and how the change was accomplished are very salient questions. The A2C2 researchers have conducted structured, scenario driven interviews with current flag and general officers to try and gain insight into what may cause adaptation in organizations. The results of these interviews were incorporated into this first experiment, providing the basis for the experimental scenarios and conditions. One common belief was that the emerging common operational picture will allow "flatter" architectures. Lower level commanders will be able to compare the current situation to the commander's intent and act accordingly, with less guidance; and thus higher level commanders will be able to increase their span of control.

In conjunction with the field research, new initiatives such as *C4I for the Warrior* and *Copernicus* also "...call for flattened command structures in order to exploit sensor-to-shooter communications capabilities and dominant battlespace knowledge." (Kemple, Kleinman, Berigan, 1996) "But, there is a paucity of empirical findings showing whether flattening is better for military organizations, and if so, when. The specific research issue, then, is: 'Can tasks differ in coordination requirements in such a way that an *organization* structure with more layers is better for some tasks, while a structure with fewer layers is better for others?'" (Kemple, Kleinman, Berigan, 1996)

The purpose of this experiment was to examine the relationships between command and control architectures and different types of tasks that involve competition for scarce assets. A common operational picture of a joint area of operations was presented to participants using the Distributed Dynamic Decisionmaking III (DDD-III) simulator to try and provide insights on the effect of dominant battlespace knowledge. By

varying organization and task structures, the DDD-III was used to gain information on the outcomes of specific competition events and the processes used to arrive at those outcomes.

2. Questions

The first A2C2 experiment was designed as an integration vehicle for the projects efforts thus far and as a baseline for further research. There were a extensive number of research issues motivated by initial field research. This initial experiment addresses the issue, presented above, that; "can tasks differ in coordination requirements in such a way that an organization structure with more layers is better for some tasks, while a structure with fewer layers is better for others?" (Kemple, Kleinman, Berigan, 1996)

Questions specific to this thesis are:

1. Are there statistically significant differences in the outcomes of competition events based on the particular experimental conditions imposed?
2. Is there a viable method for determining the processes involved in the resolution of competition events, and can it be accomplished without the use of experimental observers, i.e., can a tool be developed to determine the processes used in the resolution of competition events (or any events) after an experiment is conducted?

3. Approach

For the initial A2C2 experiment, the overall approach was to take the scenario presented in the field research, abstract it to fit the DDD-III simulation in terms of varying the task and organization structures, test the effects of varying task and organization structure on teams in the laboratory, and evaluate the results.¹ After two hours of initial DDD-III workstation familiarization, which included two practice scenarios, teams were

¹ A full treatment of the abstraction of the joint scenario is presented by Kemple, Kleinman, Berigan, 1996 and Berigan, 1996.

presented with four different scenarios. These four scenarios contained all of the experimental treatments. Twice during the conduct of a scenario, play was frozen and the players were given a situation awareness probe in the form of a questionnaire. In addition, trained observers monitored the conduct of competition events and scored the teams against a previously determined set of possible processes (mission threads). At the end of each scenario, the players were given a post-trial questionnaire and a task load questionnaire. The observers also completed teamwork and performance rating forms on the teams and recorded mission and strength scores. At the end of the four scenarios, the players were given a post experiment questionnaire. Minitab[®], a computer-based statistical package was used to evaluate the empirical data (mission, strength, and competition scores, and task latency) to determine if significant differences existed between treatments. As part of this thesis, a suite of programs to determine the processes used to resolve competition events was developed to support post-experiment analysis. These programs are based on AWK, a UNIX-based data retrieval and sorting utility.

4. Anticipated Results

It was hypothesized that tasks involving competition over assets owned by one of the players responsible for the prosecution of the tasks could best be resolved with the presence of a common commander, one organizational level above the competing players, yet removed from the overall mission commander (a three-tier structure). Also, tasks involving competition for assets not owned by either player responsible for the prosecution of the tasks could best be resolved by the overall mission commander (a two-tier structure).

C. EXPERIMENT PARTICIPANTS

The initial A2C2 experiment was conducted at the Naval Postgraduate School (NPS) in Monterey, CA. The experiment was designed and conducted by a team consisting of NPS faculty and students and representatives from Alphatec, Inc. The 24 experimental participants were military officers from the Joint Command, Control, Communications, Computers, and Intelligence (Joint C4I) curriculum at NPS. The participants were organized into four, six-person teams based on service and occupational specialty.

D. EXPERIMENT SCOPE

This experiment was a tier-1 experiment, performed in a controlled, laboratory environment. The scenarios were adapted from the one used in the previous field work (Kemple, Kleinman, Berigan, 1996), and abstracted enough to be feasibly conducted using the DDD-III environment. This experiment was designed to bring together the different aspects of the A2C2 project, and to provide direction in developing future research efforts. Also, there were several more definitive objectives, including: "adapting an existing research simulator (the DDD) [Song and Kleinman, 1990] to a broader operational domain; examining C2 structure as an independent variable; identifying from the literature, field research, and interviews salient research issue(s) that are common to the operational and theoretical domains; developing joint scenario(s) and task structures down to a level amenable to analytic modeling and simulation; providing insight into wargame/simulator requirements for future experiments; and examining measures that may be useful for research into adaptive C2 structures." (Kemple, Kleinman, Berigan, 1996)

II. EXPERIMENTAL DESIGN

A. OVERVIEW

The initial A2C2 experiment was developed by a team of NPS faculty and students and representatives of Alphatec, Inc., to test hypotheses regarding task and organizational structure concepts. This experiment used the DDD-III simulator to provide a common operational picture for the subjects and an adaptable platform for the research team. Due to constraints imposed by time and the availability of subjects, the scenarios consisted of four teams of six subjects. These subjects filled the roles of commanders in a JTF involved in an amphibious operation. The positions were the CJTF, a Ground Component Commander (GCC) or Maritime Component Commander (MCC) depending on the scenario, a Carrier Battle Group Commander (CVBG), an Amphibious Ready Group Commander (ARG), and two Marine Expeditionary Commanders (MEU1 and MEU2). The research team provided the subjects with DDD-III tutorials and an Operations Order (OPORDER). The DDD-III provided the common operational picture and preformatted messages for communications between subjects while recording subject actions and calculating outcome measures for analysis. A team of trained observers was present to record and assess subject actions. Further details describing the setup, the hypotheses, assumptions, statistical design, measures, and instrumentation are provided in the following sections.

B. SETUP

1. Physical

The experiment was conducted in the Systems Technology Laboratory at the Naval Postgraduate School, Monterey, CA from 4-8 March 1996 and 11-15 March 1996. All of the subjects were located in the same portion of the Systems Technology Laboratory, but were separated by partitions to preclude discussions. The scenarios were played on seven SUN SPARCTM workstations through the DDD-III simulation program. The simulation program provided a Graphical User Interface, complete with a tactical map background and platform specific icons. The simulation also provided the researchers with the ability to speed up, slow, or stop play. (Kemple, Hutchins, Kleinman, Sengupta, Berigan, Smith, 1996) These features were all used during the conduct of the experiment.

Subject input was controlled by a standard SUN SPARCTM three-button mouse. This was the only input device required for the scenarios. Menus were available for all required actions, including communications. All communication between subjects was through pre-formatted computer messages available to every subject. A standard keyboard was used only for starting each scenario. Each subject was provided with a common operational picture so that they could examine any part of the battle space if desired. This common operational picture was also displayed on a projection screen for use by the experiment observers.

a. Scenarios

The scenarios developed for this experiment involved a hypothetical Joint Task Force (JTF) that was stood up by the Commander-in-Chief, Mediterranean in order

to capture the port and airfield of Eastport. The scenario was adapted from the scenario used for joint officer interviews in an earlier part of the project. [Kemple, Kleinman, Smith, Entin, 1996] The Commander, Joint Task Force (CJTF) had the following forces at his disposal:

- A carrier battle group (CVBG)
- An amphibious ready group (ARG) with two Naval Surface Fire Support (NSFS) ships assigned
- Two Marine Expeditionary Units (MEUs)
- SR-71 reconnaissance assets
- One squadron of Air Force F-15s

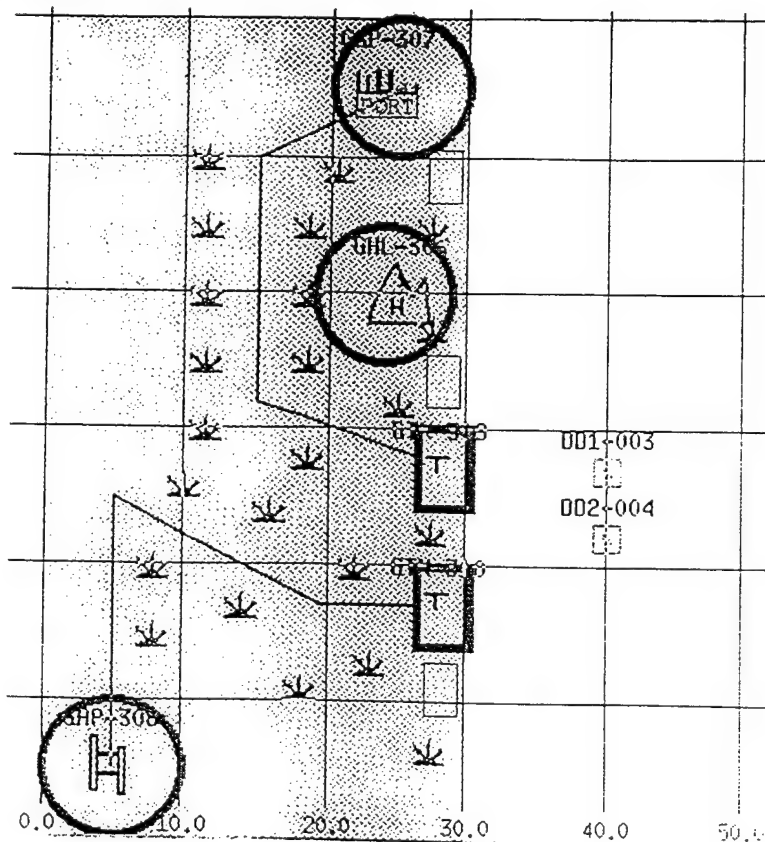


Figure 2-1. Example of Land Area and Key Features

The order of battle called for the ARG to land both MEUs on possibly contested beaches. The approaches to the beaches were possibly mined. MEU 1 was assigned the mission of assaulting Red Beach and the terrain overlooking Red Beach. MEU 2 was assigned the mission of assaulting Blue Beach. The MEUs were to then proceed from the assault beaches to their respective objectives: MEU 1 to the port, MEU 2 to the airfield. The airfield mission took priority over the port mission. Along the way the MEUs could expect possible artillery attacks, tank attacks, FROG missile attacks, and land mines.

While the land battle progressed, the maritime forces could expect attacks by Silkworm missiles, Boghammer boats, Hind attack helicopters, and submarines. The maritime forces were also tasked to provide Naval Surface Fire Support (NSFS), MEDEVAC support, and tactical air support in addition to battling enemy naval and air forces. The CJTF had dedicated reconnaissance and reinforcement assets. Complete scenarios and operations orders are contained in Appendix A.

b. Task Structures

The scenarios contained modules which involved competition among the lowest echelon units in a common functional area, ground (MEUs) or maritime (ARG/CVBG), because there was a shortage of assets to perform all of the required tasks simultaneously. Competition was either between units for assets that were assigned to one of the units (organic), or between units for assets that were assigned to a unit higher in the chain of command (non-organic). Modules 1 and 2 required the ground units to compete for organic and non-organic assets, respectively. Modules 3 and 4 required the maritime

units to compete for organic and non-organic assets, respectively. Each scenario contained similar modules. For example, if the ground units were competing for organic assets (Module 1), the maritime units were also competing for organic assets (Module 3). (Berigan, 1996)

c. Organizational Structures

In each of the scenarios, the lowest echelon units had imposed on them either a hierarchical (three-tier) or a flattened (two-tier) command structure. In order to keep the number of test subjects consistent throughout the scenarios, the command structures were mixed in the scenarios; one functional area was played with a hierarchical command structure while the other functional area was played with a flattened command structure. In the hierarchical structure, the lowest echelon units reported to a common functional commander, the Maritime Component Commander (MCC) or Ground Component Commander (GCC). In the flattened command structure the lower echelon units reported to the CJTF. The task structures and command structures were combined to produce four different scenarios.

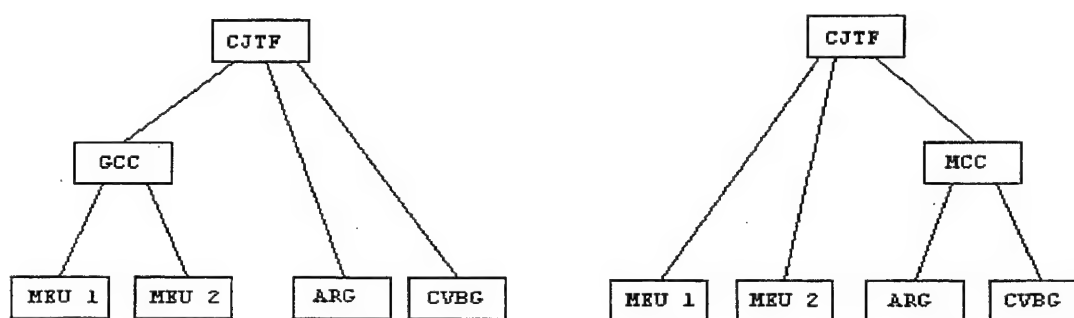


Figure 2-2. Hierarchical and Flattened Command Structures for each functional area

It was important from an analysis standpoint to keep the scenarios as uniform as possible in terms of workload and competition events. This was accomplished by carefully

crafting the scenarios to ensure that there was balance throughout. The workload between the ground and maritime forces was also carefully controlled by inserting events that would coincide with the key competition events and give the subjects a uniform workload distribution. An organizational flow chart for each scenario can be found in Appendix C.

2. Test Subjects

The 24 test subjects were military officers from the Joint Command, Control, Communications, Computers, and Intelligence (Joint C4I) curriculum at the Naval Postgraduate School. The test subjects were organized into four, six-person teams based on service and occupational specialty. There were 15 Navy officers, 3 Army officers, 2 Air Force officers, and 4 Marine Corps officers. With the exception of one Air Force O-2, all of the officers were in the O-3 and O-4 paygrades. Twenty of the twenty-four officers held operational billets during their careers.

3. Special Equipment

The Distributed Dynamic Decisionmaking (DDD) simulator used in this experiment is an extension of previous DDD editions used for research on command and control-related topics. The particular version used in this experiment, the DDD-III, was the result of extensive programming efforts at NPS and the University of Connecticut. The DDD-III provides a multi-subject, real-time environment that can be used in tier-I experiments to study pure (distributed) information processing problems, pure (distributed) resource allocation problems, or a hybrid. (Kleinman, Young, and Higgins, 1996). The DDD-III also provides the ability to control the task and information structures so that they can be

used as independent variables. Along with this ability to control independent variables is the ability to tailor data collection. The DDD-III can collect performance and process measures which are determined by the researcher prior to the play of a scenario. The simulation also collects data on all aspects of the play of the scenario in a log file. This log file can be used to rerun a scenario to generate dependent variable files, to see how a scenario was played, or to generate new performance or process measures that may be required by the researcher.

One of the distinct advantages of the DDD-III is its basis in UNIX. This provides many different methods of performing data extraction and analysis. One of the major contributions of this thesis is a suite of programs designed to extract information from the log files. These programs can be adapted for searching for and retrieving data that may be needed for future analyses.

4. Schedule

The test subjects participated in a three-phase testing process. The first phase consisted of an introduction to the A2C2 experiment. The subjects were given an overview of the experiment and scenarios, provided with the OPORDER, and informed of the times they were expected in the lab. The second and third phases were conducted on two teams per week. The second phase was a series of four familiarization trials using the computers and simulation software. These consisted of two, two-hour training sessions in which teams were exposed to all organizational structures. Competition events were not used in the training scenarios in order to avoid data contamination. The third and final phase, data collection, consisted of four, one-hour trials in which the teams were exposed

to all of the experimental treatments. Each trial consisted of a forty minute scenario. The scenario was stopped twice at specified times to administer a situational awareness questionnaire. After playing the scenario, teams were administered post-trial questionnaires. In order to accomplish all of these additional written questionnaires, teams were allotted one hour per trial. Table 2-1 illustrates the schedule of experimental trials.

	Group A	Group B	Group C	Group D
Session 1	13MCC	24GCC	13GCC	24MCC
Session 2	24GCC	13MCC	24MCC	13GCC
Session 3	13GCC	24MCC	13MCC	24GCC
Session 4	24MCC	13GCC	24GCC	13MCC

Table 2-1. Counterbalanced Experimental Trials

The scenario names are a combination of the module numbers and the common functional commander. There were four modules. Modules one and three are organic competition modules for the ground and maritime players, respectively. Modules two and four are non-organic competition modules for the ground and maritime players, respectively. GCC is the ground component commander, MCC is the Maritime Component Commander.

C. HYPOTHESES

The purpose of this experiment was to examine the relationship between command and control architectures and types of tasks. The general hypothesis is: "that there is an interaction between task structure and organization structure, and, more specifically, that when two units in the same functional area must coordinate the use of assets in order to process their individual tasks:

- 1) An organization with a common functional commander is better when the assets are owned by one of the two units, whereas,

- 2) An organization without a common functional commander is better when the assets are owned outside the functional area.” (Kemple, Kleinman, Berigan, 1996)

D. ASSUMPTIONS

Two assumptions were necessary, given the diverse mixture of operational backgrounds in the subject pool. The first was that the subjects' previous operational experience would be sufficient to enable them to play their roles in the experiment. To make this a valid assumption, the scenarios and decisions were abstracted to a level commensurate with the level of operational knowledge of the subject pool. The second assumption was that the decisionmaking results of a single officer were reasonable approximations of those of actual commanders and their staffs. This was required because it was infeasible to conduct laboratory experiments with large staffs. The teams were provided with all of the information normally available to commanders and their staffs to allow them to focus on the cognitive aspects of the commanders' roles. (Kemple, Kleinman, Berigan, 1996)

E. STATISTICAL DESIGN OF EXPERIMENT

As stated, the goal of this experiment was to study the relationships between certain organizational and task structures. Thus, there were two factors, Organizational structure and Task structure. They were controlled at two levels each, leading to a 2^2 factorial design with four unique scenarios. Each team played all four scenarios, with the order counterbalanced to control for a learning effect. The two levels of Organizational structure were:

- A three-tiered structure with a common functional commander (MCC/GCC),
- A two-tiered structure with no common functional commander.

The two levels of Task Structure were:

- The lowest echelon units competing for organic assets,
- The lowest echelon units competing for non-organic assets.

The particular scenario determined which functional area, ground or maritime, had which organizational structure in place and also what types of competition events were to take place.

F. MEASURES

1. Outcome Measures

Seven quantitative (outcome) measures were collected during this experiment. Four of these measures were automatically recorded by the simulation, the other three were collected by trained observers. These measures were:

- Average latency time to complete a (class of) tasks once they appear (e.g., suppress artillery).
- Mission Score: The accuracy with which mission tasks (weighted by their importance) were completed.
- Strength Score: The summation of all friendly force losses arising from attacking a neutral, enemy penetration of a defense zone, or improper resource allocation to an attack.
- Time the airfield was captured.
- Time the port was captured.

- Number of enemy penetrations of ground and maritime defense zones.
- Competition score from observer rating forms.

(Kemple, Kleinman, Berigan, 1996) This thesis analyzes average latency, mission score, strength score, and competition scores. They are explained below.

Each of these outcome measures is used to gain insight about how the teams performed. The average latency was an indicator of how well the team was working together, anticipating requirements, and resolving conflicts. The mission score was a measure of whether the team accomplished all of its objectives, and, if not, it gave some indication of how well the subjects prioritized tasks. The strength score reflected how well the team did in recognizing the high priority threats and resolving competition for scarce assets correctly. The time of capture for the port and airfield also indicated whether competitions were dealt with correctly, as dictated by the OPORDER. (Kemple, Kleinman, Berigan, 1996) The last item, competition score, was developed to determine how well teams resolved a competition events. It is discussed below.

2. Competition Score

Military members of the research team determined what some of the possible courses of action were for each competition event. Six possible courses were then assigned values independently by the military members of the research team based on military experience and knowledge of the scenarios. These values were then averaged to determine a value for each possible course and presented to the research team for final approval prior to testing. During the experiment, members of the the research team,

acting as observers, recorded how conflicts over the prescribed events were resolved.

(Kemple, Hutchins, Kleinman, Sengupta, Berigan, Smith, 1996)

3. Subjective Measures

The final types of measures used were subjective self-report measures. These took the form of a *Current and Future Priority of Tasks and Assets* questionnaire, a *Post-Trial Questionnaire*, a *Task Load Index (TLX) Workload Questionnaire*, and a *Post-Experiment Questionnaire*. The *Current and Future Priority of Tasks and Assets* questionnaire was administered twice per scenario during pre-determined stop points. The other measuring instruments were administered at the end of the trial. In addition, each experiment monitor was given an *Observer Form for Rating Competition Over Assets* to be completed during the trial and a *Teamwork and Performance: Observer's Rating Form* to be completed at the end of each trial. These instruments are included to completely describe the experiment. Analysis of the data gathered from these instruments is not part of this thesis. Samples of these measurement instruments are provided in Appendix B.

4. Mission Threads

Analysis of any process measure can be accomplished by extraction and analysis of data in the log files from the simulations. Examples of process measures include communications flow, communications ratios, and response delays. Another area of interest was mission threads. A mission thread consists of the sequence of actions used to accomplish a task. These threads can be as simple as the record of when and how assets were transferred and used to prosecute a task, or as complex as the record of all actions taken to prosecute a task. These actions can include movement of assets through the

game space, transfer of assets between subjects, information transfer and dissemination among subjects, and communication between subjects. The product is essentially the "path" taken to prosecute a task. A major effort of this thesis was to develop and test a tool that would allow further research into mission threads, without requiring researchers to replay the scenario from the log files and try to obtain information from the display.

G. TESTING AND PILOT TRIALS

A series of preliminary tests were conducted using student members of the research team as subjects in each of the training and evaluation scenarios. Evaluation of validity with respect to movement and attack actions, workload, timing of *Current and Future Priority of Tasks and Assets* questionnaires and *Post-Trial Questionnaires* were all performed. Prior to the actual scenarios conducted on the subjects, the observers received training in the application of the *Teamwork and Competition: Observer's Rating Form* and *Observer Form for Rating Competition Over Assets* instruments. The application was validated during the initial training scenarios.

With the exception of the *Current and Future Priority of Tasks and Assets* questionnaire and the *Observer Form for Rating Competition Over Assets* instruments, which were being tested, all of the other instruments have been validated in previous experiments dealing with team and individual dynamics.

H. SUMMARY

This chapter presented a description of the setup of the initial A2C2 experiment. The physical setup, a brief description of the scenarios used, an explanation of task structure and organization structure, and information concerning the test subjects, special

equipment, and experiment schedule were provided as a foundation for the understanding of the hypotheses and assumptions. The statistical design of the experiment, the measures collected, and an overview of testing and pilot trials were included to complete the experimental design chapter. The next chapter, Data Description, discusses the data collection and its reduction.

III. DATA DESCRIPTION

A. GENERAL

The initial A2C2 experiment collected both quantitative and qualitative data for analysis. Data collection instruments include the DDD-III simulation, *Current and Future Priority of Tasks and Assets* questionnaires, *Task Load Index (TLX) Workload Questionnaires*, *Post-Trial Questionnaires*, *Post-Experiment Questionnaires*, *Teamwork and Performance Observer Rating Forms*, and *Competition Event Observer Rating Forms*. The various qualitative instruments are contained in Appendix B. This thesis concentrates on analysis of the quantitative data from the DDD-III simulation and competition event observer rating forms and development and validation of a tool for determining mission threads.

B. OUTCOME MEASURES

The outcome measures captured by the DDD-III include: average latency time, time the airfield was captured, time the port was captured, and number of enemy penetrations of defense zones. These are aggregated for each trial and stored in a dependent variable file associated with the particular trial. The competition score, mission score, and strength score were quantitative measurements reported by the human monitors. These were aggregated prior to analysis and stored in an outside data file along with the measures reported above.

C. DATA PROBLEMS

A small problem was encountered with the strength scores in the scenarios where competition for organic assets occurred. It was found that insufficient time was built into

the scenario to properly attack one of the competition tasks. As a result, hits occurred against penetration zones or improper assets were used to attack the task. The strength scores for these trials were adjusted upward (by the amount of strength score lost) to remove this bias. All other data were used as received from the DDD-III and observers. Significant difficulties were encountered in using the log files for mission thread analysis. These difficulties are addressed in the following paragraph.

The DDD-III collects many different types of information on all subject actions. However, each action is concerned with different types of information, such as movement vectors, asset vectors, and communications permissions. This makes it very difficult to standardize output. For example, an action called ASSET_TRANSFER contains information on the subject performing the action, a code indicating what type of action (in this case asset transfer), the time the action occurred, who transferred the asset, who received the asset, the asset identification number (Platform_ID), and whether the transfer was normal or forced. On the other hand, communication between subjects contained information on the subject performing the action, a code indicating what type of action (in this case communication), the time the action occurred, who initiated the communication, who received the communication, and the text of the communication. The important information required for tracing mission threads included the action code, the task identification number (Task_ID), and the Platform_ID. Depending upon which type of action was being investigated, the Task_ID and Platform_ID numbers were contained in different fields, or were prefixed by letter codes in communications text. In addition, the Platform_ID number could not be directly mapped back to a specific platform type as

these numbers were assigned sequentially according to when the asset was launched in the scenario.

D. DATA TABLE CODING SCHEME

1. Competition Scores

The weighted competition scores were entered in a spreadsheet based on task structure, organization structure, and component. This was viable because each score was an aggregate of events that occurred to either the ground or maritime side in the scenario. As stated previously, the maritime and ground sides were in different organizational structures in the same trial. There were 32 different combinations of task structure, organization structure, component, and team, and a different score was recorded for each.

2. Strength, Mission, and Average Latency

These strength and mission scores were entered in a spreadsheet based on the scenario type. Specifically, the scenario types were broken down according to which common functional commander was present (GCC or MCC) and what type of competition events had taken place (organic or non-organic). There were sixteen different combinations of organization structure, task structure, and team taking place, and each combination had a score assigned. The average latency time was entered in the spreadsheet according to the method used for the competition scores. The average latency time was an aggregation of the average latency times for all events that occurred in either the ground or maritime sides. There were 32 different combinations of task structure, organization structure, component, and team, and a different average latency was recorded for each.

3. Mission Threads

Mission threads were determined by parsing information from the log files specific to a particular task. The actions taken to build a mission thread are discussed in the analysis portion of this thesis. The output of the mission thread extraction was a collection of all the actions that occurred relative to the particular task being investigated.

E. DATA REDUCTION

The only data reduction required was to determine the average competition scores for each side in a trial and to determine the average latency for tasks for each side in a trial. This reduction was done prior to entering the data into a spreadsheet. The final data spreadsheet is contained in Appendix C.

F. SUMMARY

This chapter presented a description of the data, data problems, data table coding scheme, and data reduction. The next chapter discusses the analysis of the data, and presents results with respect to the questions and hypothesis presented in the Introduction and Experimental Design chapters.

IV. ANALYSIS

This chapter describes the analysis of the initial A2C2 experiment. It sets forth the analysis plan and detailed methodology used to perform the analysis. The detailed results of the analysis are presented in the final section of this chapter.

A. ANALYSIS PLAN

1. Outcome Measures

As stated previously, the outcome measures were aggregated into a spreadsheet format for analysis. Parametric and non-parametric analysis of the data was completed with the aid of Minitab[®]. Minitab[®] was used to perform Analysis of Variance (ANOVA) and Kruskal-Wallis Test computations on different outcome measures. For ANOVA and the Kruskal-Wallis Test, Minitab[®] generates p-values that indicate the probability of observing outcomes like those observed or more unusual, under the assumption that the dependent variables were effected the same by all levels of the independent variables. Tests of significance at $\alpha = 0.05$ were used as rejection criteria for the null hypotheses. When the p-value is less than the critical value ($\alpha = 0.05$) there is a 95 percent confidence that any change in the dependent variable was caused by a change in the independent variable, not a random occurrence. Minitab[®] was also used to employ other non-parametric methods which utilize binary variables and binomial probabilities to gain insights into the data.

2. Mission Threads

To demonstrate the AWK programs, analysis of mission threads was performed on selected mission threads extracted using the tools developed for this thesis. A comparison

was made between mission threads of competition events of the same type (organic) using both two-tier and three-tier organization structures. Two display methods, flowcharts and graphs, were used to gain insight into the effects of organization structure and task.

B. METHODOLOGY

1. Outcome Measures

Analysis of the outcome measures was accomplished using ANOVA for balanced designs and the Kruskal-Wallis Test. The weighted competition scores and the average latency values were analyzed using three-factor ANOVA to test for main effects and interactions. The mission and strength scores were analyzed in the same manner, only using two-factor ANOVA. It is important to note that when choosing ANOVA, the assumptions are made that the data are normally distributed with constant variance. The results were examined to determine which independent variable or combination of independent variables had a statistically significant effect on the chosen outcome measures. Of special interest were the interactions between task structure and organization structure and organization structure and component. The first interaction will be used to examine the hypotheses presented in Chapter II, and the second interaction will help shed some light on any problems in the experimental design.

Since the assumptions mentioned above were in doubt, the Kruskal-Wallis Test was used to test whether there were any significant differences in the medians of the underlying distributions of latency values based on combinations of organization and task structure.

Another non-parametric method was used to test the null hypothesis that organizational structure had no effect on the latency to complete the competition events. Within each team, for each competition task within a type (e.g., organic), an indicator variable was used to record whether the team took less time in the three-tier structure than in the two-tier structure. The sum of these indicator variables across teams is distributed as a binomial random variable with n equal to the number of tasks times the number of teams. Under the null hypothesis, $p = 0.5$. This is tested against the general (two-tailed) alternative, $p \neq 0.5$.

Ho: Outcome \sim Binomial ($n, p = 0.5$)

Ha: Outcome \sim Binomial ($n, p \neq 0.5$)

2. Mission Threads

Information on mission threads was contained in the log files from each trial. The size of the log file was on the order of one hundred kilobytes (100KB) per file, and an effective and efficient means for extracting data was required. The author chose to take advantage of the UNIX-based architecture of the DDD-III log files and employed a data collection and sorting program called AWK. AWK stands for the initials of its writers.

a. AWK

AWK programs perform searches of data files in much the same manner as a human being would look at printed medium. The program moves line by line through the data file and looks for specific patterns. An action is then performed with the data that matches the specified pattern. (Aho, Kernighan, Weinberger, 1988) The original version of AWK was written in 1977 by Alfred V. Aho, Brian W. Kernighan, and Peter J. Weinberger. Its intended purpose was data extraction, partitioning, and analysis. It has

gone through several improvements since its origin and still remains a powerful (if somewhat unwieldy) weapon for data sorting and extraction. Its usefulness is fully realized when faced with trying to scan the DDD-III records, since each record contains all of the information necessary to describe an action.

AWK treats data as “records” and “fields.” Since the DDD-III log files consist of time-stamped records with information in different fields, writing AWK programs became a matter of determining what record separators and field separators are used in DDD-III, and what fields contained the required information. There were several different AWK programs developed for this thesis. Each program performed a search for a particular piece of information, and all programs were modified to search for other information. Most AWK programs consist of only a couple of lines of code.

b. File Partitioning

File partitioning was accomplished using the principle of “divide and conquer.” Each log file was initially partitioned into separate files based on subject action codes such as ASSET_TRANSFER, ATTACKING, SEND_MESSAGE, INFO_TRANSFER, ASSIGN_TASK, and TASK_PENETRATE. Generation of these files allowed other AWK programs based on Task_ID and Platform_ID to be used to further partition the files. To begin, the Task_ID for specific competition tasks were determined based on the scenario in question. The ATTACKING file was then partitioned based on the Task_ID numbers of interest. The resulting output was delivered to a collection file. This collection file was then scanned to determine the specific Platform_ID’s used to conduct the attack. The output from this scan was used as input

for another program used to scan the ASSET_TRANSFER file. The output from the ASSET_TRANSFER data extraction program was then delivered to the collection file.

Task_ID's were used as search parameters in several other programs. These programs extracted the actions performed which contained the particular Task_ID's in question from the remaining subject action files. The output from these programs was delivered to the collection file. This output file then contained all of the important actions undertaken to accomplish the specified tasks. The AWK programs and a tutorial are found in Appendix D.

C. RESULTS

1. Test of Outcome Measures

a. Weighted and Ranked Competition Scores

Analysis performed on the weighted scores for competition tasks did not indicate any significant effects from task structure, organization structure, or component. Nor were there any effects demonstrated that would support interactions between any of the treatments. The results of the three-way ANOVA, which included interactions, are illustrated in Table 4-1.

Source	DF	SS	MS	F	P
Task (A)	1	185.28	185.28	3.91	0.060
Org Str (B)	1	66.13	66.13	1.39	0.249
Component (C)	1	0.38	0.38	0.01	0.929
Task x Org Str (A x B)	1	10.72	10.72	0.23	0.639
Task x Component (A x C)	1	6.43	6.43	0.14	0.716
Org Str x Component (B x C)	1	20.07	20.07	0.42	0.522
Task x Org Str x Component (A x B x C)	1	15.37	15.37	0.32	0.574
Error	24	1138.53	47.44		
Total	31	1442.90			

Table 4-1. ANOVA (All Interactions) for Weighted Competition Scores

Though not significant at $\alpha = 0.05$, the p-value of 0.06 for Task, when compared to the other p-values seems to indicate that task structure has a more significant effect than any other independent variable.

Several of the paths through the competition events received very close elicited weights from the military raters, so ANOVA using the ranks of the paths was conducted to see if procedures designed to force more diverse weights might be useful in future research.

Analysis of the ranked competition scores gave stronger indication of an effect of task on competition score.

Source	DF	SS	MS	F	P
Task (A)	1	7.431	7.431	6.23	0.020
Org Str (B)	1	1.288	1.288	1.08	0.309
Component (C)	1	0.160	0.160	0.13	0.718
Task x Org Str (A x B)	1	0.756	0.756	0.63	0.434
Task x Component (A x C)	1	0.266	0.266	0.22	0.641
Org Str x Component (B x C)	1	0.858	0.858	0.72	0.405
Task x Org Str x Component (A x B x C)	1	0.366	0.366	0.31	0.585
Error	24	28.622	1.193		
Total	31	39.747			

Table 4-2. ANOVA (With All Interactions) of Ranked Competition Scores

The p-value of 0.02 indicates significant effect of task on ranked competition score. The effect of task on ranked competition scores is even more pronounced when an ANOVA with only two interactions (Task x Org Str, Org Str x Component) is performed.

Source	DF	SS	MS	F	P
Task (A)	1	7.431	7.431	6.60	0.016
Org Str (B)	1	1.288	1.288	1.14	0.294
Component (C)	1	0.160	0.160	0.14	0.709
Task x Org Str (A x B)	1	0.756	0.756	0.67	0.420
Org Str x Component (B x C)	1	0.858	0.858	0.76	0.391
Error	26	29.254	1.125		
Total	3	39.747			

Table 4-3. ANOVA (Two Interactions) on Ranked Competition Scores

The p-value of 0.016 indicated very strongly that Task has an effect on ranked competition score. When looking at ANOVA results based on ranks, it must be noted that the Normality assumption does not hold, so results are not exact.

Examination of boxplots (Figures 4-1 and 4-2) for each set of data showed that the ANOVA assumption of constant variance across task structures was a cause for concern. But, task still appears to have a major effect when compared to other factors.

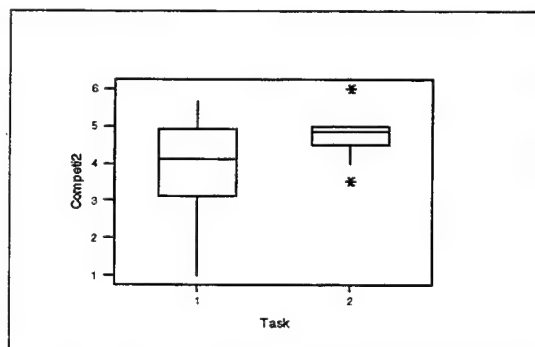


Figure 4-1. Boxplot of Task vs. Ranked Competition Scores

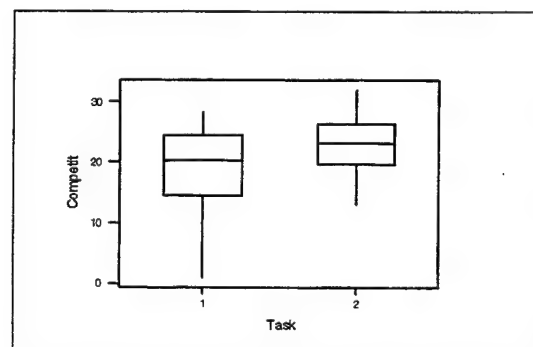


Figure 4-2. Boxplot of Task vs. Weighted Competition Scores

b. Mission Score

ANOVA performed on mission score indicated that mission score was not affected by the either task structure (organic vs. non-organic) or organization structure (GCC vs. MCC).

Source	DF	SS	MS	F	P
GCC/MCC	1	30.25	30.25	0.76	0.398
Org/Norg	1	1.00	1.00	0.03	0.876
Error	13	514.75	39.60		
Total	15	546.00			

Table 4-4. ANOVA of Mission Score

c. Adjusted Strength Score

ANOVA performed on the adjusted strength scores did not indicate a very strong effect of either task or organization structure, with p-values of 0.172 for each treatment. Examination of the boxplots (Figures 4-3 and 4-4) showed that the variances were probably not equal. This indicated that the ANOVA results were suspect.

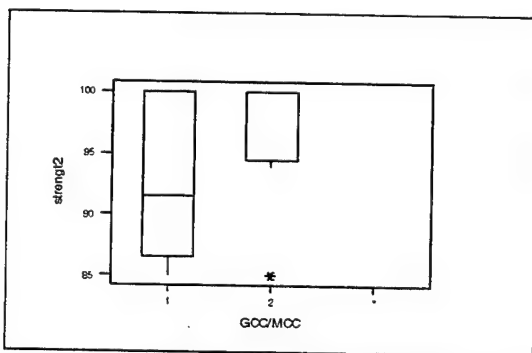


Figure 4-3. Boxplot of Adjusted Strength vs. Organization Structure

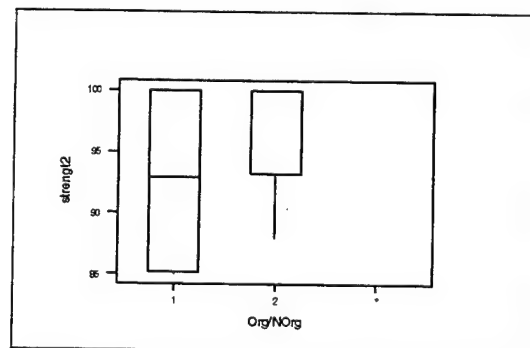


Figure 4-4. Boxplot of Adjusted Strength vs. Task Structure

d. Average Latency

ANOVA performed on the average latency values (Table 4-5) indicated

Component ($p = 0.001$), and Task ($p = 0.023$) are significant, while Organization ($p = 0.117$) is not.

Source	DF	SS	MS	F	P
Task (A)	1	64339	64339	5.87	0.023
Org Str (B)	1	28912	28912	2.64	0.117
Component (C)	1	162494	162494	14.82	0.001
Task x Org Str (A x B)	1	17032	17032	1.55	0.225
Task x Component (A x C)	1	12306	12306	1.12	0.300
Org Str x Component (B x C)	1	5130	5130	0.47	0.501
Task x Org Str x Component (A x B x C)	1	17501	17501	1.60	0.219
Error	24	263170	10965		
Total	31	570884			

Table 4-5. ANOVA for Average Latency

None of the interactions indicated any significant effect on average latency. After examining the descriptive statistics and boxplots for average latency, it appeared that some of the variances might be different and that there was some skewing of the data. If the assumption that the data is normally distributed with a constant variance is true, then the residuals from the analysis of variance should be normally distributed. A normal plot (Figure 4-5) of the residuals for average latency (using the Anderson-Darling Normality Test at $\alpha = 0.05$) indicates that the normality assumption is probably invalid ($p = 0.044$)². Consequently, the non-parametric Kruskal-Wallis test was performed on the average latency values.

² The Anderson-Darling Normality Test states that if the p-value is less than the significance level (α), reject the null hypothesis

Normal Probability Plot

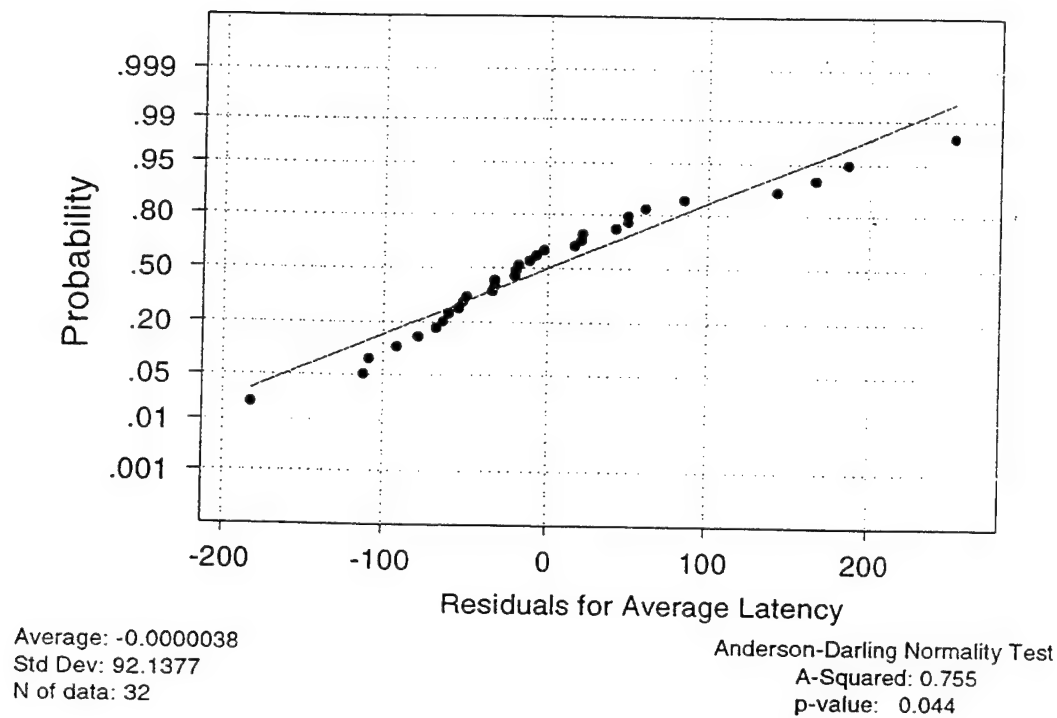


Figure 4-5. Normal Plot of Residuals for Average Latency

The input for the Kruskal-Wallis test consisted of average latency values and combinations of task and organization structure. There were four different possible combinations of task and organization structure, each with 8 associated values. The Kruskal-Wallis Test returned a p-value of 0.127 (adjusted for ties) with three degrees of freedom. With $\alpha = 0.05$, the author failed to reject the null hypothesis that the underlying distributions are identical. Results are presented in Table 4-6.

LEVEL	NOBS	MEDIAN	AVE. RANK	Z VALUE
7	8	261.8	12.9	-1.26
8	8	253.6	13.4	-1.09
12	8	302.7	16.2	-0.09
13	8	399.8	23.5	2.44
OVERALL	32	16.5		
H = 6.54	d.f. = 3	p = 0.089		

Table 4-6. Results of Kruskal-Wallis Test on Average Latency

With respect to the first hypothesis, the meaning of the ANOVA results presented thus far, is that there were no significant or reliable indications that three-tier organizations were better when there was competition between lower echelon players over assets owned by one of the lower echelon players.

If the hypothesis presented in this thesis is true, examination of the ANOVA results should indicate that the interaction between task structure and organization structure has a significant effect on average latency. There was again no significant or reliable result supporting this hypothesis. However, since the interaction between organization structure and task structure is of interest, a plot of the interaction between organization structure and task structure for the average latency was used to gain more information (Figure 4-6). Examination of this plot indicates that there is little difference in average latency when comparing a two-tier organization and a three-tier organization with respect to organic tasks (solid line in Figure 4-6). Similarly, there is little difference in average latency when comparing a two-tier organization and a three-tier organization with respect to organic and non-organic tasks (2 left points in Figure 4-6). The difference appears when comparing a two-tier organization and a three-tier organization with respect to non-organic tasks. The dashed line in Figure 4-6 indicates that there is a difference in

average latency between two-tier and three-tier organization structures when looking at non-organic competition events. This lends support to the second part of the general hypothesis, that a two-tier structure is better when there is competition between lower echelon players for assets not owned by either of them.

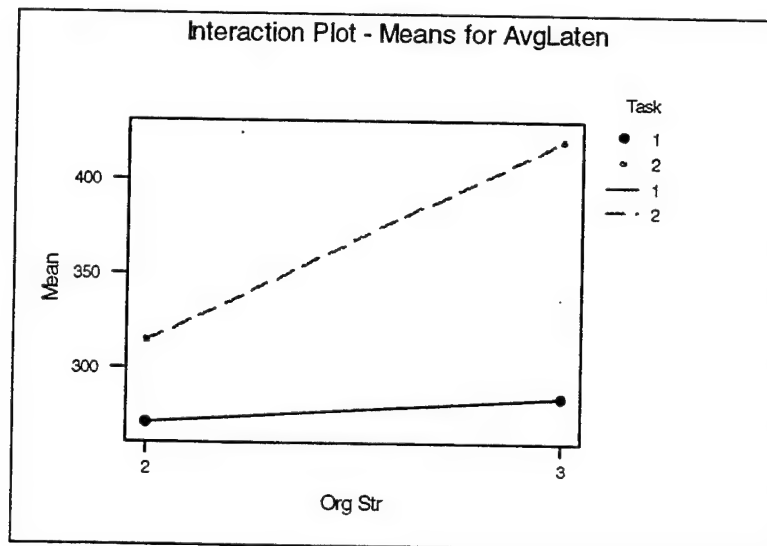


Figure 4-6. Interaction between Organization Structure and Task for Average Latency Scores

e. Reported Latency

The reported latency values for each specific action required to complete a competition event were examined using a non-parametric test. Each competition event had from two to six different actions that had to be completed before the competition event was resolved. Depending upon the task structure (organic or non-organic) and the task types (ground or maritime) there were 3 to 4 different competition events to be completed. Comparisons of the latency times for the two architectures were made between actions for tasks of the same type (ground or maritime) within the same task structure (organic or non-organic). A binary variable (1 or 0) was generated according to

the condition that if three-tier latency was less than two-tier latency, a value of one was returned. If this condition was false, a value of zero was returned. The sum of the binary values for each task type (ground and maritime) was taken separately. This value was then compared to a binomial distribution with n = the total number of tasks of each type for all teams and $p = 0.5$.

The test was conducted using the cumulative probability distribution of the binomial distribution with n and p specified as above and the sum of the binary variables as the test statistic. The value returned was the probability that a value more extreme than the test statistic would be observed, if the null hypothesis was true. Since this hypothesis test was a two-tailed test, the p -value for the test statistic was doubled and compared at $\alpha = 0.05$. If the value returned was less than 0.05, the null hypothesis was rejected. If the value returned was greater than 0.05, the author failed to reject the null hypothesis.

Results are presented in Table 4-7.

Task Structure	Task Type	n	x	One-tailed p-value	Two-tailed p-value	Decision
Organic	Ground	24	6	0.0113	0.0226	Reject Null Hypothesis
Organic	Maritime	24	14	0.2706	0.5412	Fail To Reject
Non-Organic	Ground	32	16	0.4300	0.8600	Fail To Reject
Non-Organic	Maritime	24	11	0.4194	0.8388	Fail To Reject

Table 4-7. Results of Binomial Non-Parametric Test on Reported Latency Values

The results in Table 4-7 indicate that for ground tasks under an organic task structure there is a difference between two-tier and three-tier organizations. A review of the data used for this test indicated that a three-tier organization performed worse than a two-tier organization. This counters the hypothesis that the three-tier structure would

perform better under these circumstances, at least for latency. Although the hypothesis is rejected, there were some underlying factors that may have had an effect.

The ground component commander (or the middle tier) in the three-tier organization was, due to the constraints of the subject pool, a Navy surface warfare officer vice an Army or Marine Corps officer. Observations during the trials seemed to indicate that the level of knowledge and competency of these subjects with respect to ground operations was lacking. In addition, these same individuals, again due to constraints imposed by the availability of subjects, played the role of the maritime component commander in different trials. This movement between functional areas may have confused some of the subjects, thus generating the results presented above. The results for the interaction between task structure and organization structure Table 4-6 may have been affected by the results displayed above. Another possibility is that the common operational picture mitigated the need for a common superior to resolve competition over organic assets. The lower level commanders were able to assess the overall situation and act in accordance with the commander's intent rather than focusing only on their own areas.

2. Mission Threads

Two different visual methods were used to investigate mission threads, flow charts and graphs. Flow charts were used to illustrate the progression of actions which resulted in the prosecution of a competition event. Bar graphs and line plots were used to examine, in a visual manner, the number and types of actions performed to prosecute a task. The information used to generate these visual representations came from the

collection file of the AWK process. Appendix D was used as the "Rosetta Stone" for the translation of numbers into meaningful data.

a. Flow Charts

Flow charts were useful in examining the progression of actions which resulted in the prosecution of a competition event. Each node in the flow chart gives the time an action took place in the scenario, who performed the action, who "received" the action, and amplifying information dependent upon the type of action. Symbology in the flow charts followed the following format:

Rectangle:	Communication
Parallelogram:	Intelligence Information Transfer
Trapezoid:	Asset Transfer
Heptagon:	Attack

Arrows connecting the nodes indicates flow through time. Examples of flow charts for one competition event, for one team, under the two different organization structures are presented in Figures 4-7 and 4-8. The flow charts are useful for presenting an easy to follow visual representation of the important parts of the processes undertaken to conclude a competition event, and they show that the "paths" taken under the two organizational structures by this team are quite different. Examination of the flow charts for all teams for each event may reveal important trends, but the analysis by itself is subjective.

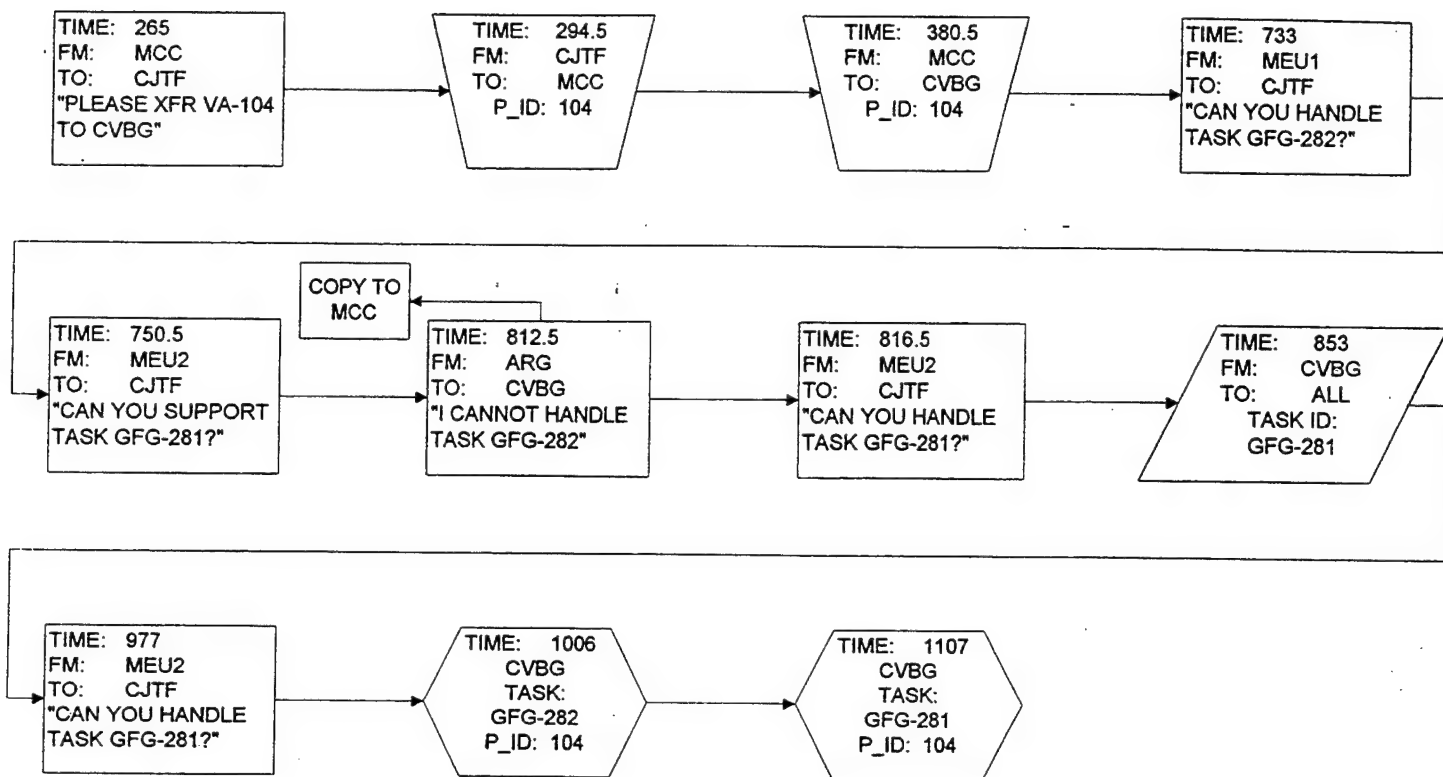


Figure 4-7. Flow chart of Organic Competition Task (Two-Tier)

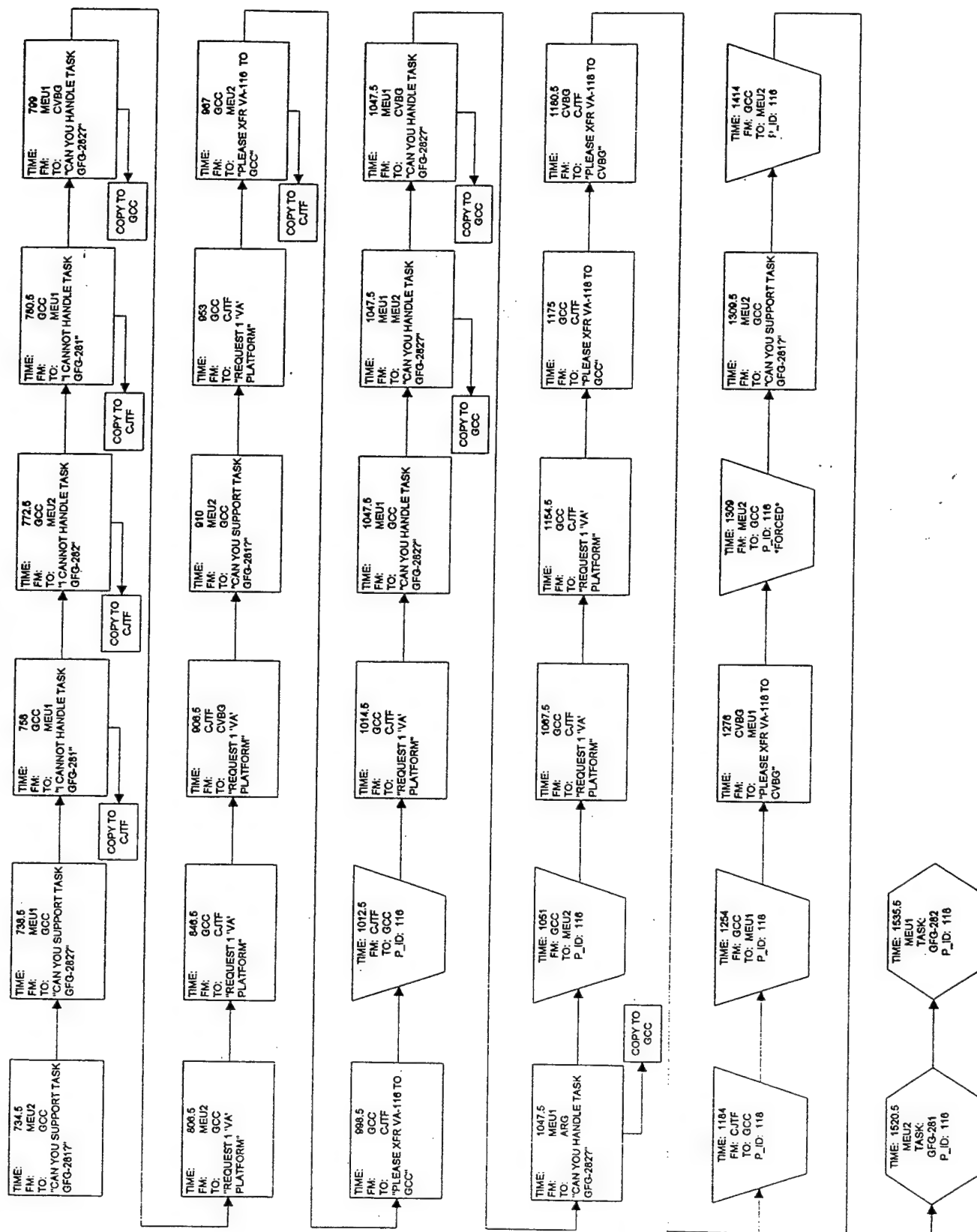


Figure 4-8. Flow Chart of Organic Competition Task (Three-Tier)

b. Graphs

To quantitatively compare the mission threads, graphs were generated using the number of instances of specific actions performed by each team under each organizational structure. A scatter plot of total numbers of actions taken to perform a task based on organization structure was generated (Figure 4-9) and, bar graphs of a specific competition event for all teams and organization structures (8 total) were generated and arranged for comparison in Figure 4-10. Neither plot supports either of the hypotheses.

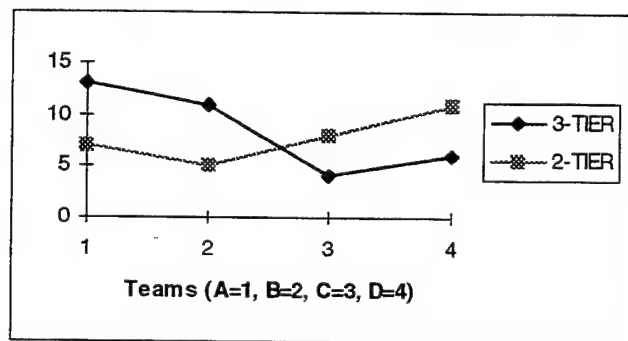
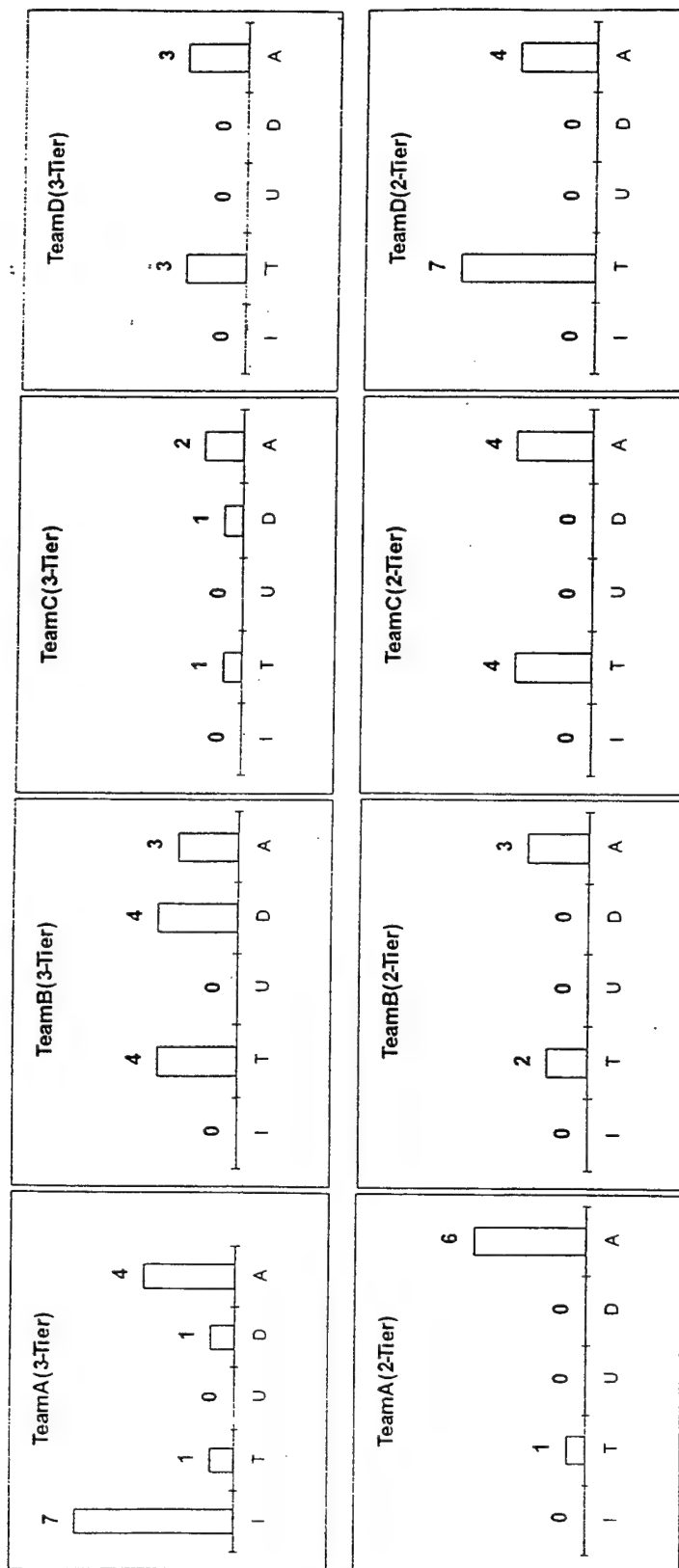


Figure 4-9. Numbers of Actions Taken to Complete a Competition Event Based on Organization Structure for an Organic Task



KEY

I =
T =
U =

INFORMATION TRANSFERS
ASSET TRANSFERS
COMMS UP TO SUPERIOR

D = COMMS DOWN TO SUBORDINATE
A = COMMS ACROSS SAME ECHELON

Figure 4-10. Number and Types of Subject Actions for a Competition Event

V. CONCLUSIONS

A. QUESTIONS

This thesis sought to answer two questions:

1. Are there statistically significant differences in the outcomes of competition events based on the particular experimental conditions presented?
2. Is there a viable method for determining the processes involved in the resolution of competition events, and can it be accomplished without the use of experimental observers, i.e., can a tool be developed to determine the processes used in the resolution of competition events (or any events) after an experiment is conducted?

The answers to these questions are presented below.

1. Statistical Analysis

The statistical analysis for this thesis was done to test the general hypothesis "that there is an interaction between task structure and organization structure, and, more specifically, that when two units in the same functional area must coordinate the use of assets in order to process their individual tasks:

- 1.) An organization with a common functional commander is better when the assets are owned by one of the two units, whereas,
- 2.) An organization without a common functional commander is better when the assets are owned outside the functional area." (Kemple, Kleinman, Berigan, 1996)

The ANOVA results of analysis done on weighted and ranked competition scores, mission score, adjusted strength score and average latency provided no significant or reliable indications that three-tier organizations were better when there was competition between lower echelon players over assets owned by one of the lower echelon players. Similarly, there was no indication from the ANOVA results that two-tier organizations are

better when there is competition between lower echelon players for assets not owned by either of them. There was some support for part (2.) of the hypothesis when the plot of the interaction between organization structure and task structure for average latency (Figure 4-5) was examined. The two-tier organization appeared to perform better than the three-tier organization with respect to competition over non-organic assets.

The other important result noted was that task structure had a significant effect on competition scores (ranked and weighted with no interactions) and average latency. The possible causes for average latency are somewhat obvious, but the causes for the competition scores are not readily apparent. In order to obtain assets owned at a higher level, communications had to pass through an extra layer between the user and the provider, resulting in an increase in latency.

The results of the Kruskal-Wallis Test also failed to support the general hypothesis. If the interaction between organization structure and task structure had an effect on average latency, then the values produced by different combinations these variables should be from different underlying distributions. The Kruskal-Wallis Test with ($\alpha = 0.05$) failed to detect a significant difference in the underlying distributions.

The non-parametric test performed on the reported latency values produced significant results. It found that for organic, ground-type tasks that the three-tier organization performed worse than the two-tier organization. As stated in the Chapter IV, this result may be an anomaly caused by the experimental conditions of using a Surface Warfare Officer as both a Ground Component Commander and a Maritime Component Commander.

Overall, it was found that there was no significant statistical evidence to support the general hypothesis.

2. Mission Threads

A suite of programs was developed to analyze the DDD-III log files. These programs provided an effective means for extracting the data necessary to determine mission threads. The graphical methods presented as analysis tools, graphs and flowcharts, provided the means for analysis of mission threads. Both methods are useful for indicating trends, but the analysis by itself is subjective in nature.

VI. RECOMMENDATIONS

Recommendations for future experiments are presented in the areas of data collection and output. Issues regarding experimental design are contained in Kemple, Hutchins, Kleinman, Sengupta, Berigan, Smith, 1996.

A. DATA COLLECTION

The DDD-III allows the user to specify what information is collected and processed by the simulation. This experiment used measures that were known from previous decisionmaking experiments to be useful for analysis. These measures also proved useful in this experiment. However, these measures did not provide enough detail to answer some of the questions that arose during the analysis for this thesis. Specifically:

- 1.) Average latency values were useful for this thesis, but the reported latency values were also required. These values were contained in the log files, and suite of programs developed as part of this thesis was used to extract that information. In order to facilitate a full analysis of the data from just the dependent variable files, it is recommended that both average and reported latency values be collected.
- 2.) The "proper attack" flag, located in the "ATTACKING" record was of limited use. This flag only indicates that a proper mix of assets was used to prosecute an attack, not that a specific platform was used to prosecute an attack. It is recommended that either a change be accomplished to reflect the use of the proper platform. A more simple solution would be that platform assets and required assets be uniquely matched, but this is scenario dependent.

3.) The Platform_ID number should map back to a distinct platform or subplatform, not be sequentially assigned according to appearance in the scenario as it is now.

B. DATA OUTPUT

The UNIX-based architecture of the DDD-III allows the data output in the log files to be easily analyzed using the suite of programs developed for this thesis.

Unfortunately, there is still some effort required to process the log files. This extra effort can be alleviated by standardization of the log file output. This would allow an AWK program to be written that could perform all of the required operations to determine mission threads (or any other measure) quickly and easily. A recommended format is presented below.

```
dm ##### current_time
dm todm copy_to type
Platform_ID#1 Platform_ID#2 Platform_ID#3
Task_ID dm delay expertise
{amplifying information dependent upon action}
```

This format contains most of the important information required for sorting files using the tools developed for this thesis. Taken with 3.) above this should allow one short program to efficiently sort through the log files.

APPENDIX A: SCENARIOS AND OPERATIONS ORDERS

Modules 1 and 2

22 Feb 96

Situation and Mission Common to Both Modules

General - Orange, a friendly nation is under attack by Green. Green forces have taken control of the Orange port of Eastport. JTF is organized by CINCMED in order to take port and airfield of Eastport. The JTF commander has at his disposal a CVBG, a large ARG, two separate MEU (SOC)'s, one missing its platoon of engineers and its Cobras, and a specified number of sorties from the carrier's air wing. JTF Mission: to take the port and airfield at Eastport, to allow for the introduction of follow-on forces in order to drive the Green forces from Orange.

Situation on Ground:

The actual port of Eastport is too high risk for hiliborne assault or across the beach assault because of obstructions, mines, obstacles, and the presence of hidden enemy among the port facility buildings with SA-7/14. About 5 miles south of the port, there are two suitable beaches. The northernmost beach (designated "Red Beach") has a road leading from it to the port, and the southernmost beach (designated "Blue Beach") has a road leading from it to the airfield. The waterborne approaches to the beaches are possibly mined, and a piece of commanding terrain to the north of Red Beach is occupied by an enemy heavy mortar platoon with a platoon of infantry for security. this commanding terrain dominates both Red Beach and the port, and must be taken and held throughout any attack on Red Beach and the port.

Known to be at the port, but hidden from view, is a company-sized mechanized counterattack force that could move toward red beach to try to foil any amphibious assault. It is possible that there is a similar counterattack force at the airfield, which is located about 5 miles inland from Blue Beach. The counterattack forces could inflict serious damage if they are not interdicted before they make it to either beach once they begin movement. The only asset that the JTF possesses that will be effective against these mechanized counterattack forces are the AH-1W Cobras. The off-road terrain between the beach, port, airfield, and commanding terrain is swampy and treacherous, and is unsuitable for travel. Thus, **all travel must be on the two roads**. It is suspected that one or both of the roads will be mined, but the locations of any minefields are unknown, and will not be known until friendly units approach them. These "pop-up" minefields must be breached by engineers before the friendly forces can move beyond them.

The port, airfield, both roads, both beaches, and the commanding terrain are located within range of two artillery strongpoints, one about 10 miles northwest of the port, and the other about 10 miles south of the airfield. The northernmost strongpoint can range Red Beach and the port, the southernmost strongpoint can range the airfield and Blue Beach. Both are within range of two NSFS stations off the port – one in support of MEU 1, and the other in support of MEU 2. The artillery pieces at both strongpoints are housed in reinforced concrete bunkers, and the ammunition is stored in deep underground

bunkers, so it is unlikely that even concentrated air attacks by the assets under the JTF's control will completely disable the artillery strongpoint. When the enemy wants to fire and artillery barrage, they wheel out the artillery pieces (anywhere from 8 to 24 at a time), set them up, sight them, and fire within 5 minutes. If friendly forces can get effective NSFS on target in less than 5 minutes, the enemy will wheel their artillery pieces back into their bunkers and wait until another time.

The enemy also has several FROG missile launchers that are known to be capable of carrying chemical munitions hidden in the vicinity of both artillery strongpoints. They can emerge from their covered positions, prepare their warheads, and fire their missiles within 30 minutes. Past experience has shown that the FROG crews are more stalwart than their artillery comrades – they will continue to prepare and launch their missiles even if they are being suppressed by NSFS or artillery. CAS aircraft with precision guided munitions are the only weapon in the JTF's possession that is highly effective against this target, if the aircraft can get airborne in time.

Friendly - The JTF exists within the structure of the Mediterranean Command (MEDCOM). There is a theater-level JFACC and other friendly forces operating against the enemy in Orange, but not in concert with the JTF. The only aircraft that the CVBG will have available to support the JTF are one section of FA-18's with laser guided bombs (LGB's) to attack FROG launchers, and another to attack confirmed Silkworm missile sites. The CVBG will also man 2 CAP stations, one above the CVBG and the other above the ARG. All other CVBG assets will be supporting the theater JFACC, and will be unavailable for JTF use. Two DD's will be in position to provide NSFS against either artillery strongpoint, and will man fire support stations (FSS) about 4 miles directly east of the port. The ARG has an MCM helicopter embarked (which is retained as a CJTF asset) which can clear mines if detected.

MEU 1 is composed of one AAV mounted company, one V-22 mounted heliborne company, one division (4) Cobras (indivisible), and one V-22 mounted engineer platoon. MEU 2 is composed of one AAV mounted company, one V-22 mounted heliborne company, and 2 MEDEVAC helicopters (also indivisible). MEU 1 has the Cobras and Engineers because it is considered probable that the port will have more mechanized assets and minefields than the airfield. The CJTF controls the CAS, and also retains one V-22 mounted heliborne company as the JTF reserve on the LHD.

Mission: (for ground units; sea-based units are covered in modules 3 and 4)

To secure the port and airfield of Eastport, to allow for the introduction of follow-on forces.

Execution: (for ground unit; sea-based units are covered in modules 3 and 4)

Each MEU will simultaneously land one AAV-mounted company on the beach. MEU 1 will simultaneously take commanding terrain with one heliborne company. Once the beach and commanding terrain are secure, the two AAV-mounted companies will proceed down the roads from their respective beaches, clearing minefields with the engineer platoon, killing counterattack forces with MEU 1's Cobras, and conducting MEDEVAC's as necessary.

Each MEU will have a UAV (launched from the ARG) airborne for the duration of the operation. The UAV's will keep the artillery strongpoints and the suspected FROG sites under constant surveillance, so that NSFS or CAS assets can be brought to bear immediately if they are needed. The section of CAS aircraft earmarked for use against FROG launchers will be on 5 minute strip alert aboard the CV.

Once the roads have been cleared, the AAV-mounted companies from MEU 1 and MEU 2 will then attack the port and airfield, respectively. MEU 2's AAV-mounted company will be joined in its attack by a heliborne company from MEU 2. It is important that, once the AAV-mounted companies land on the beach, the airfield and port be taken as quickly as possible, before the enemy has a chance to organize his defense and send reinforcements. We would like to conduct the final assaults on the airfield and port simultaneously, in order to present the enemy commander with the most confusing, dilemma-filled environment possible, but, if one attack must be conducted before the other, the airfield takes priority. **If the airfield attack is held up for any reason, the port attack should wait to retain the synergism of concurrent attacks; if the port attack is held up, the airfield attack should go forward.**

The CJTF (or GCC, depending upon organization structure) will keep one heliborne company in reserve. This can be requested by whichever MEU needs it.

Priorities - MEU 2's attack on the airfield has priority, because buildup of forces can be most quickly and effectively achieved through air transport.

Module 1 - Competition Between Ground-Based Units for Organic Assets

MEU 1 and MEU 2 will compete for MEU 1's engineer platoon and Cobras and MEU 2's MEDEVAC helicopters. Non-organic asset that will not be competed over, but will be used, are the reserve heliborne company, the section of CAS, and a minesweeping helicopter for clearing the beaches.

The scenario will start with MEU 2 detecting mines as it approaches the beach. MEU 2 should immediately request the MCM helicopter to clear the mines. Once the mines are clear, the air assault on the commanding terrain and the AAV assaults on Red and Blue Beaches then occur concurrently. After the AAV-mounted companies have taken the beaches and have begun moving down their respective roads, enemy tanks will be observed moving down both roads towards Red and Blue Beaches. MEU 1 and MEU 2 will compete for the Cobras – since MEU 2 has priority, the correct response would be for MEU 2 to get them first, and when MEU 2 is done, for MEU 1 to get them. Parallel with the assault, the enemy artillery will be observed coming out of its bunkers by MEU 1, who will have to call NSFS to suppress it.

Soon after the tanks appear, friendly casualties will be incurred at both beaches. MEU1's casualties will be most severe, and will need to be MEDEVAC'd first, then MEU2's. Somewhere in this timeframe, enemy artillery will again be observed coming out of its bunkers, but this time the southern strongpoint, and MEU 2 will need to bring NSFS to bear against the target.

After the tanks are dispatched, MEU 1 and MEU 2 can begin moving down their respective roads toward their objectives. They will simultaneously encounter minefields on the roads – MEU 2 has priority, so they should get the mineclearing assets first, then MEU 1. At about the same time as MEU 1 is clearing its mines, the northern enemy artillery reemerges from its bunkers, MEU 1 needs to suppress it with NSFS, and a FROG launcher emerges from hiding, observed by MEU 2's UAV. MEU 2 should then request standby CAS section to attack the FROG launcher. MEU 2, meanwhile, should also be conducting its coordinated attack on the airfield.

After MEU 1 finishes clearing its mines, it will attack the port. As it gets close to the port, the MEU 1 commander will realize that the enemy is stronger there than he expected. He will need to call for the reserve company before he can attack. Meanwhile, the southern artillery reemerges from its bunkers, which MEU 2 will need to suppress with NSFS.

Module 2 - Competition Between Ground-Based Units for Non-Organic Assets

In this module, the organic and non-organic assets will be the same as in module 1; however, the organic assets will not be competed over, and the non-organic assets will. The scenario will unfold as in module 1, except for the following:

- Both MEU's will simultaneously detect mines as they approach the beach. Since MEU 2's attack has priority, the mines at Blue Beach should be cleared first, then at Red Beach. Each assault should begin immediately after the mines are cleared from its respective beach.

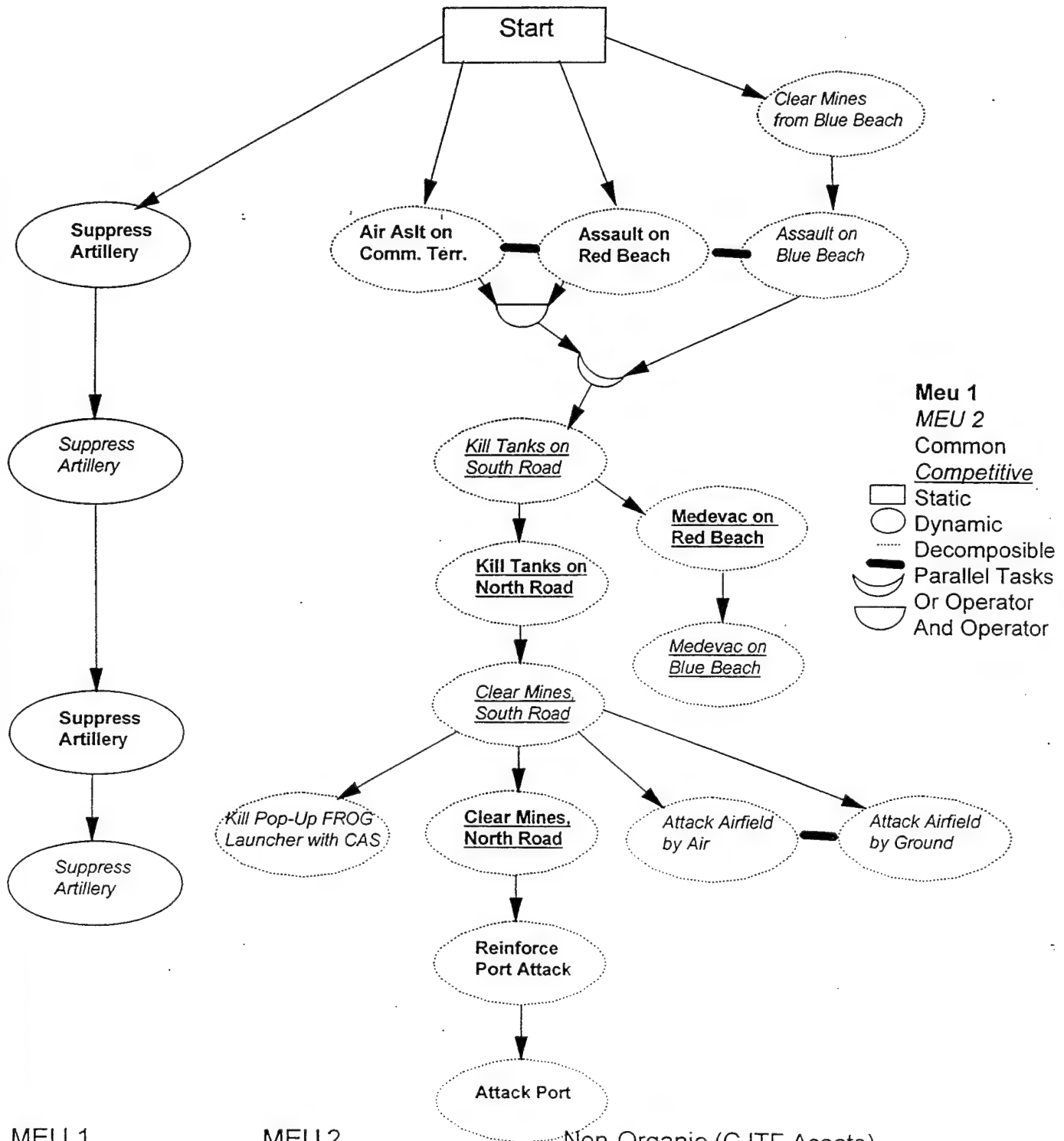
- The enemy tank column and mines will only appear on the north road, threatening MEU 1. There will then be no competition for the engineers and Cobras.

- Casualties will only be incurred by MEU 2, so there will be no competition for the MEDEVAC helicopters.

- FROG launchers will be detected simultaneously by both MEU 1 and MEU 2. Since MEU 2 has priority, it should get the CAS aircraft first.

- We will have to artificially "bog down" MEU 2's attack so they arrive at the airfield at about the same time as MEU 1, or a little after, in order to impose competition over the reserve. As both units approach their objective, it will become clear that neither will be able to take their objective without reinforcements. In that case, MEU 2 should get the reserve first, then, when the attack is successful, it should go to MEU 1.

Module 1 - Competition Between Ground Units for Organic Assets



MEU 1

1 Inf Co (AAV's)
 1 Inf Co (Heliborne)
 1 Engineer Plt
 1 Division (4) Cobras
 NSFS Platform

MEU 2

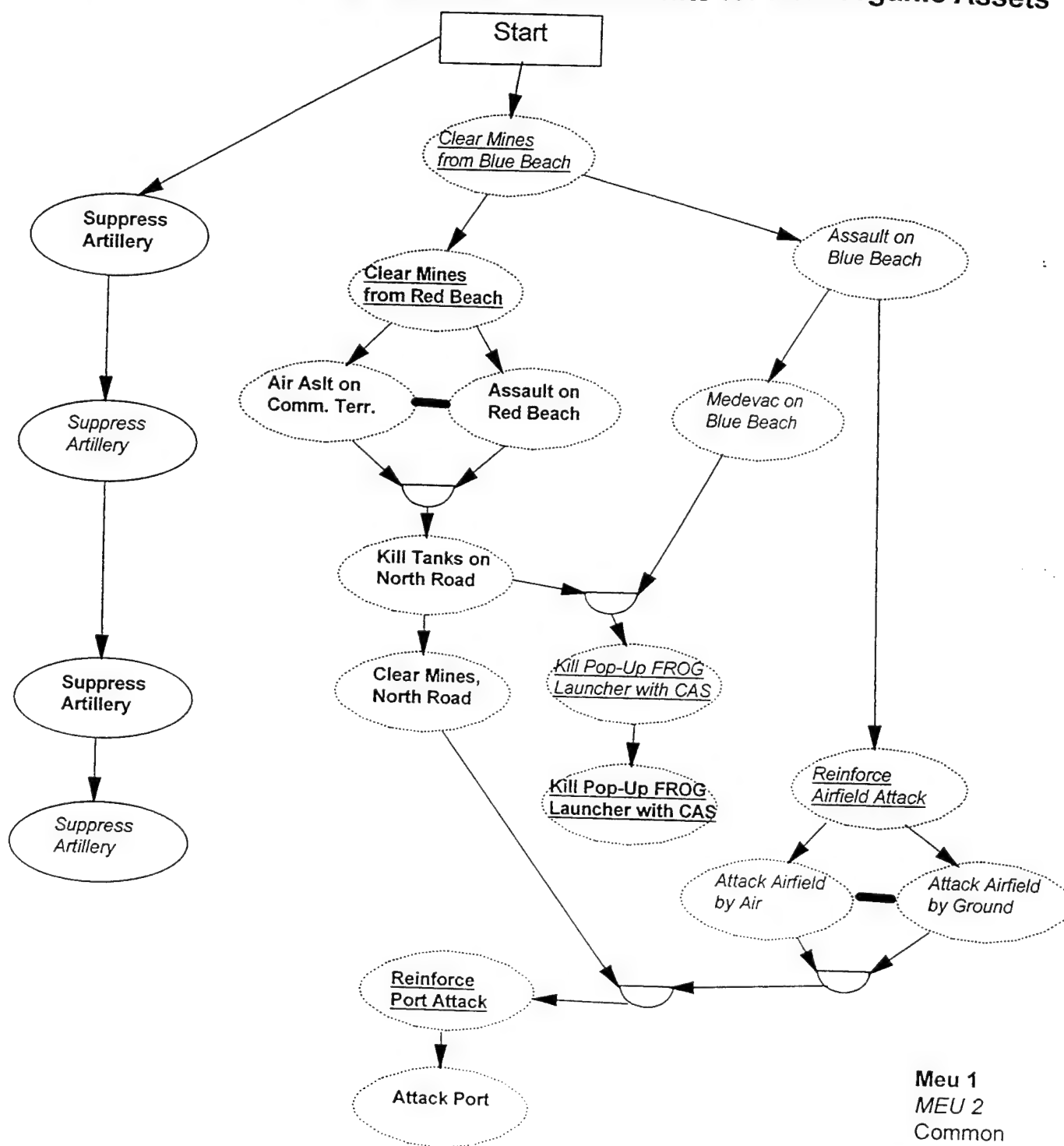
1 Inf Co (AAV's)
 1 Inf Co (Heliborne)
 MEDEVAC Helos
 NSFS Platform

Non-Organic (CJTF Assets)

1 Inf Co (Heliborne)
 1 Section CAS
 MCM Helicopters

23 Feb 1996

Module 2 - Competition Between Ground Units for Non-Organic Assets



MEU 1

1 Inf Co (AAV's)
1 Inf Co (Heliborne)
1 Engineer Plt
1 Division (4) Cobras
NSFS Platform

MEU 2

1 Inf Co (AAV's)
1 Inf Co (Heliborne)
MEDEVAC Helos
NSFS Platform

Non-Organic (CJTF Assets)

1 Inf Co (Heliborne)
1 Section CAS
MCM Helicopters

Meu 1

MEU 2

Common

Competitive



Static



Dynamic



Decomposable



Parallel Tasks



Or Operator



And Operator

23 Feb 1996

Modules 3 and 4

22 Feb 96

Situation and Mission Common to Both Modules

General - Sea based units, an ARG and a CVBG, are supporting an amphibious operation to secure the port and airfield of Eastport, Orange. Two different organizational structures will be tested, one with a flattened structure (ARG and CVBG report directly to the CJTF), and one with an intermediate maritime force commander. The ARG will be composed of 1 LHA, 1 LHD, 1 LPD, and 1 Stinger platoon for close-in air defense against helicopters.

Situation - Same as stated in modules 1 and 2. Additional information of interest to maritime units:

Submarine threat is considerable. Enemy has one Alfa-class submarine known to be in the area, and one more possible.

Enemy possesses Hind helicopters, and has demonstrated the capability to launch anti-ship cruise missiles from its helicopters. The only significant capability the ARG or CVBG possesses against these helicopters is the Stinger platoon.

The enemy has significant air strike capability, and can launch anti-ship cruise missiles from most of its strike aircraft.

The enemy's special forces also possess numerous fast patrol boats, that can either fire very potent Russian torpedoes or be loaded with explosives for suicide missions.

There is also a Silkworm threat from the city of Eastport itself and another, southern residential district. These Silkworm missiles were placed in residential neighborhoods by the enemy because they knew U.S. planners would be reluctant to target residential areas. Accordingly, if the U.S. warships want to target a Silkworm launcher, they must first get VISUAL confirmation of its presence, using theater SR-71 assets, and any strike must use precision guided munitions.

Friendly - in addition to the assets mentioned above, there is a possibility of obtaining JFACC air defense assets from Sicily in the event that the carrier-based fighters become unavailable. Also, there is a SR-71 that is constantly in orbit, in general support of the theater CINC, that can be tasked with any immediate imagery requirements. The CVBG will have a (indivisible) section of FA-18's loaded with 2, 500lb LGB each on standby to strike any confirmed Silkworm site. The CVBG will also have a section of SH-60's with Penguin missiles that belong to the CJTF to be used against any small patrol boats that threaten JTF forces. The SH-60's belong to the CJTF, and he must authorize their use.

Mission - To support the amphibious operation with CAS, naval gunfire, and air defense assets. To defend the CVBG and ARG from air, surface, and subsurface threats.

Execution - Due to hydrographic limitations, the ARG and CVBG will have to be significantly separated during the operation, enough to preclude them from being under a joint air defense umbrella provided by the Aegis cruiser. Thus, the Aegis cruiser will

remain with the CVBG, but will position itself so that it can rapidly move from the CVBG to the ARG if that becomes necessary. Additionally, the two DD's are inshore, providing NSFS support, while the FFG is the primary ASW platform for the CVBG. The FFG performing ASW will, like the Aegis cruiser, position itself so that it can quickly move to support the ARG if that is necessary. **ANY AIRCRAFT OR SHIPS SUPPORTING THE ARG MUST BE TRANSFERRED TO THE CONTROL OF THE ARG! SAME GOES FOR THE CVBG!**

The ARG will initially clear mines from the beaches with the minesweeping helicopters. Then the ARG will launch 3 companies of Marines for the initial assault on Red and Blue beaches. The ARG will launch the Cobras, MEDEVAC aircraft, the air assault for MEU2's attack on the airfield, and the CJTF reserve when called to do so.

The CVBG will keep two sections of FA-18's with LGB's on standby at all times: one to be used against FROGs (in support of the MEUs), and the other against Silkworms (in support of the CVBG and ARG). The CVBG/ARG cannot use the MEU's assets, or vice versa. The CJTF will be launch authority for both sections. The ARG will also, with its DD's providing NSFS, suppress the artillery strongpoints ashore when requested to do so by either of the MEUs.

The CVBG will provide 2 sections per hour of air defense aircraft (FA-18 or F-14), with one CAP station over the CVBG and the other over the ARG. Besides the two sections of FA-18's and the CAP aircraft, all other CVBG assets belong to the theater JFACC, and are unavailable to the JTF.

Enemy patrol boats or other surface craft will be dealt with as discussed in the situation paragraph.

Priorities - The CJTF has established the following priorities: If both the ARG and CVBG are threatened by the enemy, the ARG has priority of support against submarine threats, fixed-wing air threats, and patrol boats. **IF THERE IS A THREAT OF AN AIR ATTACK AGAINST THE ARG, THE ARG SHOULD GET THE AEGIS CRUISER AND CAP.** The FFG performing ASW and the Aegis cruiser stay with the CVBG unless a necessity occurs with the ARG, however, because the CVBG is considered a more likely target for the enemy.

The CVBG has priority against land-based Silkworm sites and helicopters. The Stinger platoon will remain on the ARG, however, because it is considered a more likely target for enemy helicopters, since the only known enemy helicopter bases are closest to the ARG, and will only transfer to the CVBG if there is evidence of an imminent attack. To expedite this transfer, should it become necessary, the Stinger platoon will have V-22 aircraft at its disposal.

Module 3 - Competition Between Sea-Based Units for Organic Assets

The CVBG and ARG, in module 3, will compete for the ARG's Stinger platoon, the CVBG's Aegis cruiser and ASW frigate, and a section of CAP aircraft (there will only be one available during the second coverage period, pre-designated for the CVBG's use). Non-organic assets that will not be competed over, but will be used, are JFACC aircraft that will become available about 1/2 hour after the competition over the CVBG's CAP in

the second coverage period, the SH-60's, the SR-71 mission, and the FA-18's to be used against Silkworms.

Shortly after the detection of mines in front of Blue Beach will be the detection of submarines moving toward the ARG and CVBG. The ARG will need to acquire the FFG from the CVBG in order to protect itself against this threat. At the same time, two sections of CAP aircraft will launch from the CV, one for the CAP station above the CVBG, and the other for the CAP station above the ARG. They will remain in station for 2 hours.

Soon afterward, and after the MEUs' assault on Red and Blue Beaches, helicopters with antiship missiles will be detected preparing to take off from an airfield within range of the CVBG and the ARG. The CVBG will need to acquire the Stinger platoon from the ARG in order to defend itself from this threat. After this and concurrently with the clearing of the minefields on the roads ashore, two things will happen. First, fast patrol boats will be detected heading toward the CVBG. The CVBG should request the SH-60's from the CJTF to destroy this threat. Also, a humint report of an air attack preparing to take off against either the ARG or the CVBG will be received by the theater CINC. The ARG should request the Aegis cruiser from the CVBG, and the CVBG should send it to the ARG. Also at the same time, both CAP stations will run out of fuel, and return to the CVN. Only one relief section will be available - prescheduled to go to the CVBG. This should be diverted to the ARG, because the ARG has priority. Soon afterward, a section of JFACC F-15's from Sicily comes out to support the CVBG.

At the same time that the JFACC F-15's come to assist, a report will then be received of a Silkworm site in the north, threatening the CVBG. The CVBG should request SR-71 overflight to confirm the missile site. After the SR-71 overflight confirms the Silkworms, the CVBG should then request launch of the FA-18's against the missile site.

Several times throughout the scenario, the artillery targets will pop up, and the MEUs will request NSFS to suppress it.

Module 4 - Competition Between Sea Based Units for Non-Organic Assets

In this module, the organic assets and non-organic assets are the same as in module 3; this time, though, the organic assets will not be competed over, and the non-organic assets will. The scenario will unfold as described above in Module 3, except for the following:

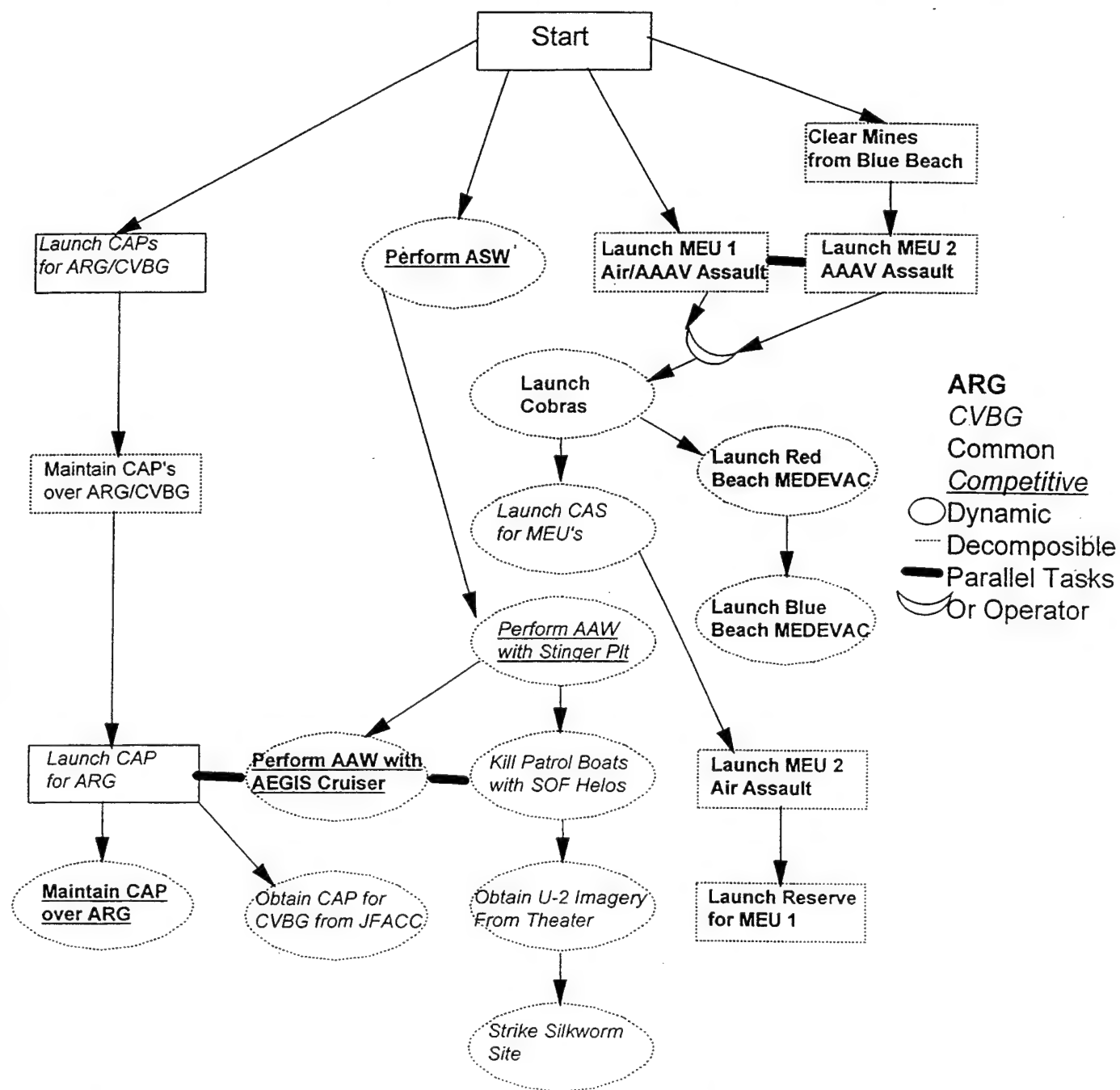
- The submarine will be detected moving toward the CVBG instead of both the CVBG and the ARG, and the correct response will be to keep the ASW FFG with the CVBG.
- The enemy helicopters detected preparing to take off will only be within range of the ARG, not the CVBG, and the Stinger platoon should stay with the ARG.
- There will be reports of two Silkworm sites instead of one, with one threatening the CVBG and the other threatening the ARG. Here, the SR-71 flyover should be

requested, but first for the CVBG, then for the ARG. Both sites will be confirmed (simultaneously), and the CVBG should get the FA-18's first, then the ARG.

The report of the air attack will be only against the CVBG. The Aegis cruiser, then, should stay with the CVBG. Also, no CAP aircraft at all will be available for the second coverage period; the ARG and CVBG will then compete over a section of CAP aircraft that becomes available almost immediately from the JFACC. The ARG should get the CAP, because the air attack is over and it has priority.

- Fast patrol boats will be detected moving toward both the ARG and CVBG. The correct response will be for the CVBG to get the SH-60 asset.

Module 3 - Competition Between Sea-Based Units for Organic Assets



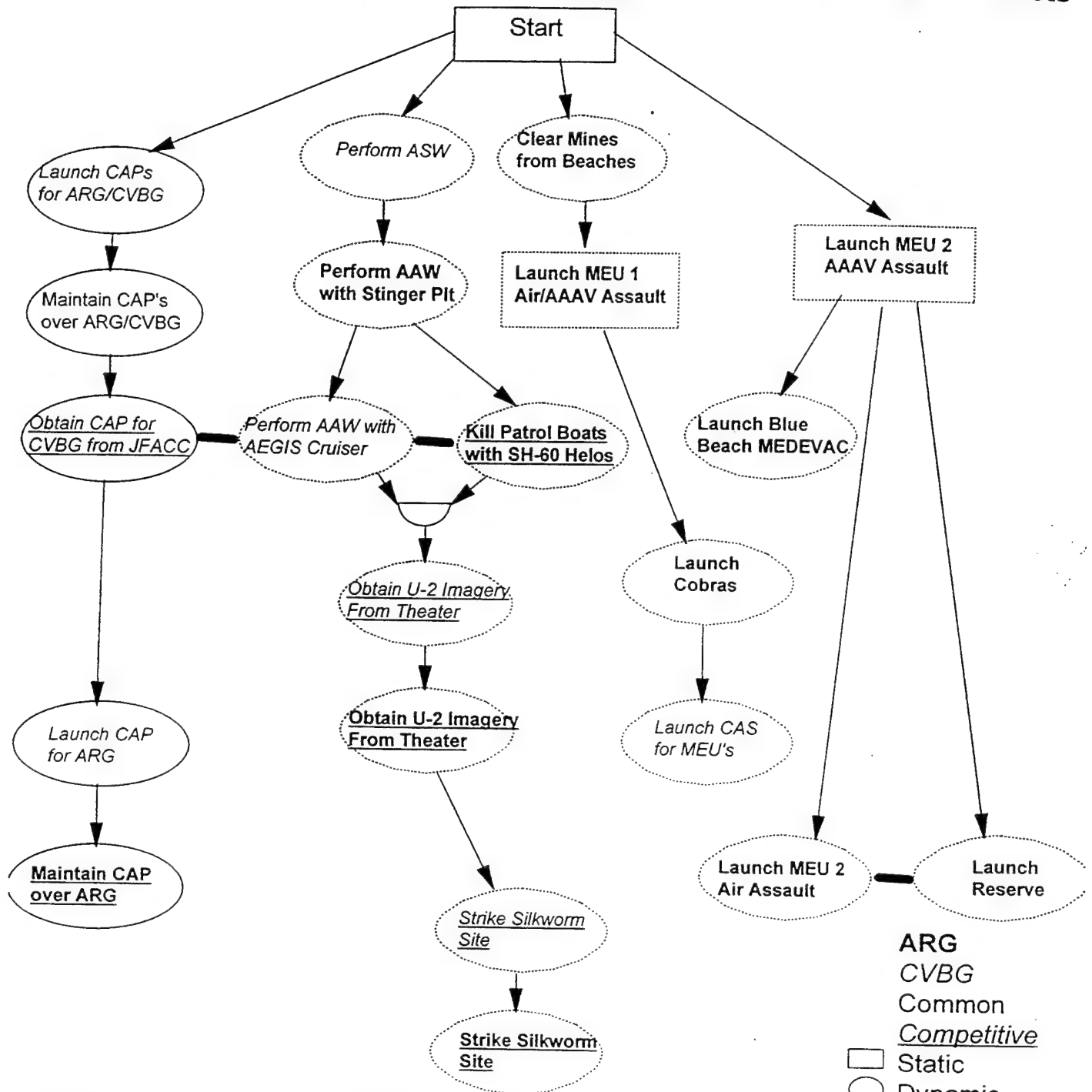
ARG
 1 LHA
 1 LHD
 1 LPD
 1 Stinger Plt
 2 DD

CVBG
 1 CVN
 1 CG (Aegis)
 1 FFG
 3 Sections CAP

Non-Organic
 JFACC F-15's
 SR-71 Mission
 SH-60 Helos
 1 Section FA-18 w/LGB
 (Silkworms)

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Module 4 - Competition Between Sea-Based Units for Non-Organic Assets



ARG
 1 LHA
 1 LHD
 1 LPD
 1 Stinger Plt
 2 DD

CVBG
 1 CVN
 1 CG (Aegis)
 1 FFG
 3 Sections CAP

Non-Organic
 JFACC F-15's
 SR-71 Mission
 SH-60 Helos
 1 Section FA-18 w/LGB
 (Silkworms)

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ARG
CVBG
Common
Competitive
 Static
 Dynamic
 Decomposable
 Parallel Tasks
 Or Operator
 And Operator

IMMEDIATE

FROM: USCINCMED NAPLES IT
JTF1000

TO: CJCS WASHINGTON DC
USCINCCENT MACDILL AFB FL
USCINCLANT NORFOLK VA
USCINCEUR VAIHINGEN GE
CINCFOR FT MCPHERSON GA
USCINCPAC HONOLULU HI
USCINCTRANS SCOTT AFB IL
USCINCSTRAT OFFUTT AFB NE
COMMARFORPAC HONOLULU HI
CINCPACFLT HONOLULU HI

INFO: WHITE HOUSE SITUATION ROOM WASHINGTON DC
SECSTATE WASHINGTON DC
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ORDTYP/OPORD/USCINCCENT 12-96//
MAP/1015/ORANGE//
MAP/1020/GREEN//
NARR/SCALE 1:100,000//
TIMEZONE/Z//

HEADING/TASK ORGANIZATION//

5UNIT

/UNITDES	/UNITLOC	/CMNTS
/USCINCLANT	/NORFOLK VA	
/USCINCEUR	/VAIHINGEN GE	
/CINCFOR	/FORT MCPHERSON GA	
/USCINCPAC	/HONOLULU HE	
/USCINCTRANS	/SCOTT AFB IL	/2 TAC ARLFT SQ
		6 KC-10
/USCINCSTRAT	/OFFUT AFB NE	/2RC-135
/COMMARFORPAC	/HONOLULU HI	/1 MEB
/CINCPACFLT	/HONOLULU HI	
/HQ USMEDCOM FWD		
/HQ USMEDAF (MINUS)		
/2 E-3A (AWACS)		
/HQ USNAVMED (MINUS)		
/SUPPORTING FORCES		
/COMSUPNAVFOR		
/CTG 60.1 (CVBG)		
ARG 55.2		
/1 MEB		
/MPS//		

GENTEXT/SITUATION/

1. (FOUO) GREEN HAS ATTACKED FRIENDLY NATION OF ORANGE. ATTACKING FORCES HAVE SUCCEEDED IN SEIZING ORANGE PORT OF EASTPORT. ORANGE GOVERNMENT HAS REQUESTED US ASSISTANCE IN TAKING BACK PORT OF EASTPORT AND DRIVING GREEN FORCES FROM ORANGE.

A. (FOUO) ENEMY FORCES

(1) (FOUO) SEE CURRENT SITREP AND DIN. PORT OF EASTPORT PROTECTED BY OBSTRUCTIONS, MINES, OBSTACLES, AND THE PRESENCE OF HIDDEN ENEMY AMONG THE PORT FACILITY BUILDINGS. TWO BEACHES APPROX 5 MILES SOUTH OF PORT MAY BE SUITABLE FOR AMPHIBIOUS ASSAULT. NORTHERNMOST BEACH (DESIGNATED "RED BEACH") HAS ROAD LEADING TO PORT. SOUTHERMNOST BEACH (DESIGNATED "BLUE BEACH") HAS A ROAD LEADING TO AIRFIELD. WATERBORNE APPROACHES TO THE BEACHES ARE POSSIBLY MINED.

COMMANDING TERRAIN TO NORTH OF RED BEACH BELIEVED OCCUPIED BY ENEMY HEAVY MORTAR PLATOON WITH PLATOON OF INFANTRY FOR SECURITY. THIS TERRAIN DOMINATES BOTH RED BEACH AND PORT. SEIZURE AND RETENTION OF THIS DOMINANT TERRAIN SHOULD BE CONSIDERED ESSENTIAL FOR SUCCESSFUL ATTACK ON RED BEACH AND PORT.

(2) (FOUO) BELIEVED TO BE AT PORT, BUT HIDDEN FROM VIEW, IS COMPANY-SIZED ARMORED COUNTERATTACK FORCE THAT COULD MOVE TOWARD RED BEACH IN RESPONSE TO ANY AMPHIBIOUS ASSAULT. SIMILAR COUNTERATTACK FORCE MAY EXIST AT AIRFIELD, WHICH IS LOCATED ABOUT 5 MILES INLAND FROM BLUE BEACH. THESE COUNTERATTACK FORCES COULD INFLICT SERIOUS DAMAGE IF NOT INTERDICTED BEFORE THEY REACH EITHER BEACH. OFF-ROAD TERRAIN BETWEEN BEACH, PORT, AIRFIELD, AND COMMANDING TERRAIN IS SWAMPY AND TREACHEROUS; AND IS UNSUITABLE FOR TRAVEL. THUS, ALL TRAVEL MUST BE ON THE TWO ROADS. IT IS BELIEVED THAT ONE OR BOTH OF THE ROADS WILL BE MINED. BUT LOCATIONS OF ANY MINEFIELDS ARE UNKNOWN. PORT, AIRFIELD, BOTH ROADS, BOTH BEACHES, AND COMMANDING TERRAIN MENTIONED EARLIER ARE LOCATED WITHIN RANGE OF TWO ARTILLERY STRONGPOINTS, ONE ABOUT 10 MILES NORTHWEST OF THE PORT, AND OTHER ABOUT 10 MILES SOUTH OF AIRFIELD. NORTHERNMOST STRONGPOINT CAN RANGE RED BEACH AND PORT. SOUTHERNMOST STRONGPOINT CAN RANGE AIRFIELD AND BLUE BEACH. ARTILLERY PIECES AT BOTH STRONGPOINTS ARE HOUSED IN CONCRETE BUNKERS, WITH AMMUNITION STORED IN DEEP UNDERGROUND BUNKERS. IT IS UNLIKELY THAT EVEN CONCENTRATED AIR ATTACKS WILL COMPLETELY DISABLE THE ARTILLERY STRONGPOINTS. ENEMY CAN BE EXPECTED TO WHEEL OUT ARTILLERY PIECES (FROM 8 TO 24 AT A TIME), SET UP, SIGHT IN, AND FIRE WITHIN 5 MINUTES. IF FRIENDLY FORCES CAN GET EFFECTIVE NSFS ON TARGET IN LESS THAN 5 MINUTES, THE ENEMY WILL MOST PROBABLY WHEEL THEIR ARTILLERY PIECES BACK INTO BUNKERS AND WAIT UNTIL ANOTHER TIME.

(3) (FOUO) ENEMY ALSO HAS SEVERAL FROG MISSILE LAUNCHERS KNOWN TO BE CAPABLE OF CARRYING CHEMICAL MUNITIONS. FROGS BELIEVED TO BE HIDDEN IN THE VICINITY OF BOTH ARTILLERY STRONGPOINTS. THEY CAN EMERGE FROM COVERED POSITIONS, PREPARE WARHEADS, AND FIRE MISSILES WITHIN 10 MINUTES. PAST EXPERIENCE HAS SHOWN THAT FROG CREWS ARE MORE STALWART THAN ARTILLERY CREWS - THEY WILL CONTINUE TO PREPARE AND LAUNCH THEIR MISSILES EVEN IF THEY ARE BEING SUPPRESSED BY NSFS OR ARTILLERY.

(4) (FOUO) SUBMARINE THREAT IS CONSIDERABLE. ENEMY HAS ONE ALFA-CLASS SUBMARINE KNOWN TO BE IN THE AREA, AND ONE MORE POSSIBLE.

(5) (FOUO) ENEMY POSSESSES HIND HELICOPTERS, AND HAS DEMONSTRATED THE CAPABILITY TO LAUNCH ANTI-SHIP MISSILES FROM ITS HELICOPTERS. THE ONLY SIGNIFICANT CAPABILITY THE ARG OR CVBG POSSESSES AGAINST THESE HELICOPTERS IS ONE STINGER PLATOON.

(6) (FOUO) THE ENEMY HAS SIGNIFICANT AIR STRIKE CAPABILITY, AND CAN LAUNCH ANTI-SHIP MISSILES FROM MOST OF ITS STRIKE AIRCRAFT.

(7) (FOUO) THE ENEMY'S SPECIAL FORCES ALSO POSSESS NUMEROUS FAST PATROL BOATS, THAT CAN EITHER FIRE VERY POTENT RUSSIAN TORPEDOES OR BE LOADED WITH EXPLOSIVES FOR SUICIDE MISSIONS.

(8) (FOUO) THERE IS ALSO A SILKWORM THREAT FROM THE CITY OF EASTPORT ITSELF AND ANOTHER, SOUTHERN, RESIDENTIAL DISTRICT. THESE SILKWORM MISSILES WERE PLACED IN RESIDENTIAL NEIGHBORHOODS BY THE ENEMY BECAUSE THEY KNEW US PLANNERS WOULD BE RELUCTANT TO TARGET RESIDENTIAL AREAS. ACCORDINGLY, IF THE US WARSHIPS WANT TO TARGET A SILKWORM LAUNCHER, THEY MUST FIRST GET VISUAL CONFIRMATION OF ITS PRESENCE, USING THEATER SR-71 ASSETS, AND ANY STRIKE MUST USE PRECISION GUIDED MUNITIONS.

B. (FOUO) FRIENDLY. JTF WILL BE COMPOSED PRIMARILY OF ASSETS ORGANIC TO MEDITERRANEAN COMMAND (MEDCOM). A THEATER-LEVEL JFACC AND OTHER FRIENDLY FORCES ARE OPERATING AGAINST THE ENEMY IN ORANGE, BUT NOT IN CONCERT WITH THE JTF.

(1) (FOUO) JTF WILL CONSIST OF ONE CVBG, A LARGE ARG, AND TWO SEPARATE MEU (SOC)S (ONE MINUS ITS PLATOON OF ENGINEERS AND ITS COBRAS). SEA BASED UNITS INCLUDE AN ARG AND A CVBG. THE ARG WILL BE COMPOSED OF 1 LHA, 1LHD, 1 LPD, 2 NSFS DD'S AND 1 STINGER PLATOON FOR CLOSE-IN AIR DEFENSE AGAINST HELICOPTERS. CVBG WILL BE COMPOSED OF 1 CVN, 1 CG, AND 1 FFG.

(2) (FOUO) THE ONLY CVBG AIRCRAFT AVAILABLE TO SUPPORT THE JTF ARE TWO SECTIONS OF FA-18'S WITH LASER GUIDED BOMBS (LGB'S). THIS IS THE ONLY WEAPON AVAILABLE TO THE JTF THAT IS EFFECTIVE AGAINST FROG LAUNCHERS (ASSUMING AIRCRAFT CAN GET

AIRBORNE IN TIME). ANOTHER SECTION OF FA-18'S WILL BE AVAILABLE TO ATTACK CONFIRMED SILKWORM MISSILE SITES.

(3) (FOUO) THE CVBG WILL ALSO MAN 2 CAP STATIONS, ONE PROTECTING THE CVBG AND THE OTHER PROTECTING THE ARG. ALL OTHER CVBG ASSETS WILL BE SUPPORTING THE THEATER JFACC, AND WILL BE UNAVAILABLE FOR JTF USE.

(4) (FOUO) TWO DD'S WILL BE IN POSITION TO PROVIDE NSFS AGAINST EITHER ARTILLERY STRONGPOINT, AND WILL MAN FIRE SUPPORT STATIONS (FSS) ABOUT 4 MILES DIRECTLY EAST OF THE PORT. THE ARG HAS AN MCM HELICOPTER EMBARKED (RETAINED AS A CJTF ASSET) WHICH CAN CLEAR MINES IF DETECTED.

(5) (FOUO) CVBG WILL HAVE A SECTION OF SH-60'S WITH PENGUIN MISSILES. THESE BELONG TO THE CJTF TO BE USED AGAINST ANY SMALL PATROL BOATS THAT THREATEN JTF FORCES. CJTF MUST AUTHORIZE THEIR USE.

(6) (FOUO) CONTINUOUS COVERAGE BY SR-71 WILL BE MAINTAINED IN GENERAL SUPPORT OF THEATER CINC. MAY BE TASKED WITH ANY IMMEDIATE IMAGERY REQUIREMENTS.

(7) (FOUO) IN ADDITION TO THE ASSETS MENTIONED ABOVE, THERE IS A POSSIBILITY OF OBTAINING JFACC AIR DEFENSE ASSETS FROM SICILY IN THE EVENT THAT THE CARRIER-BASED FIGHTERS BECOME UNAVAILABLE.

(8) (FOUO) MEU 1 IS COMPOSED OF ONE AAV-MOUNTED COMPANY, ONE V-22 MOUNTED HELIBORNE COMPANY, ONE DIVISION (4) COBRAS (INDIVISIBLE), AND ONE V-22 MOUNTED ENGINEER PLATOON. ENGINEERS MUST BE USED TO BREACH ANY MINEFIELDS ENCOUNTERED BY JTF GROUND FORCES. COBRAS ARE ONLY JTF ASSET EFFECTIVE AGAINST ARMORED FORMATIONS.

(9) (FOUO) MEU 2 IS COMPOSED OF ONE AAV-MOUNTED COMPANY, ONE V-22 MOUNTED HELIBORNE COMPANY, AND 2 MEDEVAC HELICOPTERS (ALSO INDIVISIBLE). MEU 1 HAS BEEN ASSIGNED THE COBRAS AND ENGINEERS BECAUSE IT IS CONSIDERED MORE PROBABLE THAT MEU 1 WILL ENCOUNTER TANKS AND MINEFIELDS THAN MEU 2 WILL.

(10) (FOUO) CJTF CONTROL CAS, AND ALSO RETAINS ONE V-22 MOUNTED HELIBORNE COMPANY, AS JTF RESERVE, ON THE LHD.//

GENTEXT/MISSION/

2. (FOUO) ON ORDER, JTF 1000 GROUND FORCES WILL SEIZE AND DEFEND ORANGE PORT OF EASTPORT, TO ALLOW INTRODUCTION OF FOLLOW-ON FORCES IN SUPPORT OF ORANGE GOVERNMENT TROOPS. SEA-BASED FORCES WILL SUPPORT AMPHIBIOUS ASSAULT WITH CAS, NAVAL GUNFIRE, AND AIR DEFENSE ASSETS TO DEFEND THE CVBG AND ARG FROM AIR, SURFACE, AND SUBSURFACE THREATS.//

GENTEXT/EXECUTION/

3. (FOUO) CONCEPT OF OPERATIONS.

A. GROUND. EACH MEU WILL SIMULTANEOUSLY LAND ONE AAV-MOUNTED COMPANY ON RESPECTIVE BEACH. MEU 1 WILL SIMULTANEOUSLY TAKE COMMANDING TERRAIN WITH ONE HELIBORNE COMPANY. ONCE BEACHES AND COMMANDING TERRAIN ARE SECURE, THE TWO AAV-MOUNTED COMPANIES WILL PROCEED DOWN THE ROADS FROM THEIR RESPECTIVE BEACHES, CLEARING MINEFIELDS WITH THE ENGINEER PLATOON, KILLING COUNTERATTACK FORCES WITH MEU 1'S COBRAS, AND CONDUCTING MEDEVACS AS NECESSARY. ONCE THE ROADS HAVE BEEN CLEARED, THE AAV-MOUNTED COMPANIES FROM MEU 1 AND MEU 2 WILL THEN ATTACK THE PORT AND AIRFIELD, RESPECTIVELY. MEU 2'S AAV-MOUNTED COMPANY WILL BE JOINED IN ITS ATTACK BY A HELIBORNE COMPANY FROM MEU 2. IT IS IMPORTANT THAT, ONCE THE AAV-MOUNTED COMPANIES LAND ON THE BEACH, THE AIRFIELD AND PORT BE TAKEN AS QUICKLY AS POSSIBLE, BEFORE THE ENEMY HAS A CHANCE TO ORGANIZE HIS DEFENSE AND SEND REINFORCEMENTS. WE WOULD LIKE TO CONDUCT THE FINAL ASSAULTS ON THE AIRFIELD AND PORT SIMULTANEOUSLY, IN ORDER TO PRESENT THE ENEMY COMMANDER WITH THE MOST CONFUSING, DILEMMA-FILLED ENVIRONMENT POSSIBLE. BUT, IF ONE ATTACK MUST BE CONDUCTED BEFORE THE OTHER, THE AIRFIELD TAKES PRIORITY.

B. MARITIME. DUE TO HYDROGRAPHIC LIMITATIONS, THE ARG AND THE CVBG WILL HAVE TO BE SIGNIFICANTLY SEPARATED DURING THE OPERATION, ENOUGH TO PRECLUDE THEM FROM BEING UNDER A JOINT AIR DEFENSE UMBRELLA PROVIDED BY THE AEGIS CRUISER. THUS, THE AEGIS CRUISER WILL REMAIN WITH THE CVBG, BUT WILL POSITION ITSELF SO THAT IT CAN RAPIDLY MOVE FROM THE CVBG TO THE ARG IF THAT BECOMES NECESSARY. ADDITIONALLY, THE TWO DD'S ARE INSHORE, PROVIDING NSFS, WHILE THE FFG IS THE PRIMARY ASW PLATFORM FOR THE CVBG. THE FFG PERFORMING ASW WILL, LIKE THE AEGIS CRUISER, POSITION ITSELF SO THAT IT CAN QUICKLY MOVE TO SUPPORT THE ARG IF THAT IS NECESSARY.

4. (FOUO) FIRST TASK ASSIGNMENT MEU 1. ON ORDER OF JTF REDBEARD, LAND ONE AAV-MOUNTED COMPANY ON RED BEACH. SIMULTANEOUSLY SEIZE COMMANDING TERRAIN TO THE NORTH OF RED BEACH WITH ONE HELIBORNE COMPANY. ONCE THE BEACH AND COMMANDING TERRAIN ARE SECURE, ATTACK ALONG THE ROAD FROM THE BEACH TO THE PORT WITH THE AAV-MOUNTED COMPANY, CLEARING MINEFIELDS WITH THE ATTACHED ENGINEER PLATOON, KILLING COUNTERATTACK FORCES WITH ASSIGNED COBRAS, AND CONDUCTING MEDEVACS WITH MEU 2'S MEDEVAC HELICOPTERS AS NECESSARY. ONCE THE ROADS HAVE BEEN CLEARED, ATTACK THE PORT WITH THE AAV-MOUNTED COMPANY.

5. (FOUO) SECOND TASK ASSIGNMENT MEU 2. ON ORDER OF JTF REDBEARD, LAND ONE AAV-MOUNTED COMPANY ON BLUE BEACH. ONCE BEACH IS SECURE, ATTACK ALONG THE ROAD FROM BEACH TO AIRFIELD WITH AAV-MOUNTED COMPANY, CLEARING MINEFIELDS WITH MEU 1'S ENGINEER PLATOON, KILLING COUNTERATTACK FORCES WITH MEU 1'S COBRAS, AND CONDUCTING MEDEVACS AS NECESSARY. ONCE ROADS HAVE BEEN CLEARED, CONDUCT A COORDINATED ATTACK ON THE AIRFIELD WITH YOUR AAV-MOUNTED COMPANY AND YOUR HELIBORNE COMPANY.

6. (FOUO) THIRD TASK ASSIGNMENT CVBG. KEEP TWO SECTIONS OF FA-18'S WITH LGB'S ON STANDBY AT ALL TIMES: ONE TO BE SUED AGAINST FROGS (IN SUPPORT OF THE MEUS), AND THE OTHER AGAINST SILKWORMS (IN SUPPORT OF THE CVBG OR ARG). CVBG/ARG WILL NOT TASK MEUS' AIRCRAFT, OR VICE VERSA. CJTF WILL BE LAUNCH AUTHORITY FOR BOTH SECTIONS. CVBG WILL PROVIDE 2 SECTIONS PER HOUR OF AIR DEFENSE AIRCRAFT (FA-18 OR F-14), WITH ONE CAP STATION OVER THE CVBG AND THE OTHER OVER THE ARG. ASIDE FROM TWO SECTIONS OF FA-18'S AND CAP AIRCRAFT, ALL OTHER CVBG ASSETS BELONG TO THEATER JFACC, AND ARE UNAVAILABLE TO THE JTF.

7. (FOUO) FOURTH TASK ASSIGNMENT ARG. ON ORDER OF JTF REDBEARD, ARG WILL INITIALLY CLEAR MINES FROM THE BEACHES WITH THE MINESWEEPING HELICOPTER. THEN, ARG WILL LAUNCH 3 COMPANIES OF MARINES FOR THE INITIAL ASSAULT ON RED AND BLUE BEACHES. THE ARG WILL LAUNCH THE COBRAS, MEDEVAC AIRCRAFT, THE AIR ASSAULT FOR MEU2'S ATTACK ON THE AIRFIELD, AND THE CJTF RESERVE WHEN CALLED TO DO SO. ARG WILL ALSO, WITH ITS NSFS DD'S, SUPPRESS ARTILLERY STRONGPOINTS ASHORE WHEN REQUESTED TO DO SO BY EITHER MEU.

8. (FOUO) COORDINATING INSTRUCTIONS

A. (FOUO) THIS ORDER EFFECTIVE FOR PLANNING UPON RECEIPT AND FOR EXECUTION ON ORDER.

B. (FOUO) DIRLAUTH FOR PLANNING AND OPERATIONS WITH INFO CJCS AND CINCMED.

C. (FOUO) ROE WILL BE PER POLICY IN CINCMED OPLAN 1234.

D. (FOUO) EACH MEU WILL HAVE A UAV (LAUNCHED FROM THE ARG) AIRBORNE FOR THE DURATION OF THE OPERATION. THE UAV'S WILL KEEP THE ARTILLERY STRONGPOINTS AND THE SUSPECTED FROG SITES UNDER CONSTANT SURVEILLANCE, SO THAT NSFS OR CAS ASSETS CAN BE BROUGHT TO BEAR IMMEDIATELY IF NEEDED.

E. (FOUO) THE SECTION OF CAS AIRCRAFT EARMARKED FOR USE AGAINST FROG LAUNCHERS WILL BE ON 5 MINUTE STRIP ALERT ABOARD THE CVN.

F. (FOUO) IF THE AIRFIELD ATTACK IS HELD UP FOR ANY REASON, THE PORT ATTACK WILL BE DELAYED TO RETAIN THE SYNERGISM OF CONCURRENT ATTACKS. IF PORT ATTACK IS HELD UP, AIRFIELD ATTACK WILL GO FORWARD.

G. (FOUO) THE CJTF WILL KEEP ONE HELIBORNE COMPANY IN RESERVE. THIS CAN BE REQUESTED BY WHICHEVER MEU NEEDS IT.

H. (FOUO) MEU 2'S ATTACK ON AIRFIELD HAS PRIORITY, BECAUSE BUILDUP OF FORCES CAN BE MOST QUICKLY AND EFFECTIVELY ACHIEVED THROUGH AIR TRANSPORT.

I. (FOUO) ANY AIRCRAFT OR SHIPS SUPPORTING THE ARG MUST BE TRANSFERRED TO THE CONTROL OF THE ARG. SAME PROCEDURES WILL BE IN EFFECT FOR THE CVBG.

J. (FOUO) THE SECTION OF CAS AIRCRAFT EARMARKED FOR USE AGAINST FROG LAUNCHERS WILL BE ON 5 MINUTE STRIP ALERT ABOARD THE CVN.

K. (FOUO) ENEMY PATROL BOATS OR OTHER SURFACE CRAFT WILL BE ENGAGED USING SH-60'S ARMED WITH PENGUINS.

L. (FOUO) IF BOTH THE ARG AND CVBG ARE THREATENED BY THE ENEMY, THE ARG HAS PRIORITY OF SUPPORT AGAINST SUBMARINE THREATS, FIXED-WING AIR THREATS, AND PATROL BOATS.

M. (FOUO) IF THERE IS A THREAT OF AN AIR ATTACK AGAINST THE ARG, THE ARG WILL BE PROTECTED BY THE AEGIS CRUISER AND CAP.

N. (FOUO) THE FFG PERFORMING ASW AND THE AEGIS CRUISER WILL REMAIN WITH THE CVBG UNLESS REQUIRED BY THE ARG TO MEET A SPECIFIC THREAT. IN ABSENCE OF SUCH A SPECIFIC THREAT, CVBG IS CONSIDERED A MORE LIKELY TARGET FOR THE ENEMY.

O. (FOUO) CVBG HAS PRIORITY AGAINST LAND-BASED SILKWORM SITES AND HELICOPTERS.

P. (FOUO) STINGER PLATOON IS INDIVISIBLE AND WILL REMAIN WITH ARG BECAUSE IT IS CONSIDERED A MORE LIKELY TARGET FOR ENEMY HELICOPTERS AND BECAUSE ONLY KNOWN ENEMY HELICOPTER BASES ARE CLOSEST TO THE ARG. STINGERS WILL ONLY TRANSFER TO THE CVBG IF THERE IS EVIDENCE OF AN IMMINENT ATTACK. TO EXPEDITE THIS TRANSFER, SHOULD IT BECOME NECESSARY, STINGER PLATOON WILL HAVE V-22 HELICOPTERS AT ITS DISPOSAL.

//

GENTEXT/ADMIN AND LOG/

7. (FOUO) PER CINCMED OPLAN 1234, AD AMENDED HEREIN.//

GENTEXT/COMMAND AND SIGNAL/

8. (FOUO) USCINCMED IS SUPPORTED CINC.

9. (FOUO) CJTF 1000 IS ON-THE-SCENE COMMANDER AND WILL EXERCISE OPCON OF ADVANCE FORCES UNTIL HQ USCENTMED FWD IS ACTIVATED.

10. (FOUO) COMMAND RELATIONSHIPS AS OUTLINED IN ANNEX J, CINCMED OPLAN 1234.

11. (FOUO) COMMUNICATIONS GUIDANCE AS OUTLINED IN ANNEX K, CINCMED OPLAN 1234 AS AMENDED HEREIN.//

AKNLDG/Y//

DECL/OADR//

APPENDIX B: SUBJECTIVE MEASUREMENT INSTRUMENTS

TASK LOAD INDEX (TLX) WORKLOAD QUESTIONNAIRE

Instructions

Workload is a difficult concept to define precisely, but a simple one to understand generally. The factors that influence your experience of workload may come from the task itself, your feelings about your own performance, how much effort you put in, or the stress and frustration you felt. The workload contributed by different task elements may change as you become more familiar with a task, perform easier or harder versions of it, or move from one task to another. Physical components of workload are relatively easy to conceptualize and evaluate. However, the mental components of workload are more difficult to measure, so we offer the following discussion to help you with the problem.

Workload is something that is experienced individually by each person. There are no effective "rules" that can be used to estimate the workload of different activities. One way to find out about workload is to ask people to describe the feelings they experienced. Because workload may be caused by many different factors, we will ask you to evaluate each of the component factors individually rather than lumping them into a single global evaluation of overall workload.

The six rating scales used in this workload questionnaire were developed for you to use in evaluating your experience during a particular segment of the experiment. Please read the descriptions of the scales below carefully. If you have a question about any of the scales, you can ask them now or you can hold your questions until the first workload assessment period and ask them at that time, in the context of the task you have just performed. It is important that the scales are clear to you. The descriptions of the scales will always be available to you when you do your workload ratings. Ask if you wish to review them.

You will be asked to fill out a workload questionnaire after you complete each set of experiment trials. Please respond to each of the six rating scales in terms of your experiences for that set of trials by putting an "X" at the point on the scale that matches your experience. Each scale has two endpoint descriptors that describe the scale. In five of the six scales the end points for the scale are "very low" (on the left) and "very high" (on the right). Note that "performance" goes from "perfect" on the left to "failure" on the right. This order has been confusing for some people.

Please consider your responses carefully in distinguishing among the different task conditions. Consider each scale individually. Your accurate ratings will play an important role in the evaluation being conducted.

Definition of the TLX Scales

The **mental demand** scale asks you to rate how much mental and perceptual activity was required (e.g., thinking, deciding, calculating, remembering, looking, searching, etc.). Was the task or situation easy or demanding, simple or complex, exacting or forgiving? Make this rating on a scale from very low mental demand to very high mental demand.

The **physical demand** scale asks you to rate how much physical activity was required (pushing, pulling, turning, controlling, activating, etc.). Was the task or situation easy or demanding, slow or brisk, slack or strenuous, restful or laborious? Make this rating on a scale from very low physical demand to very high physical demand.

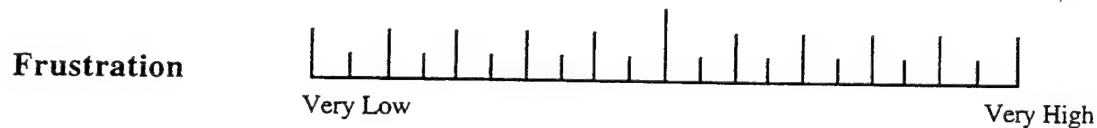
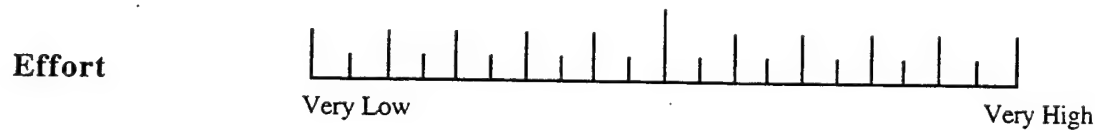
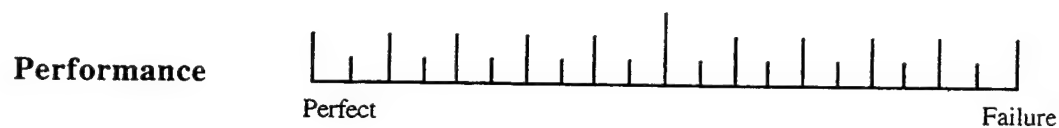
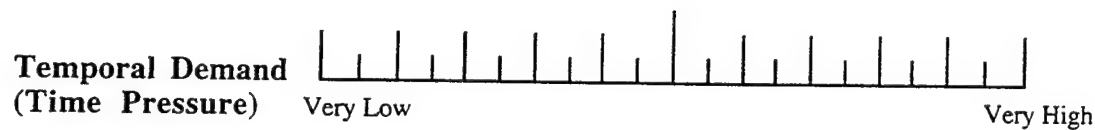
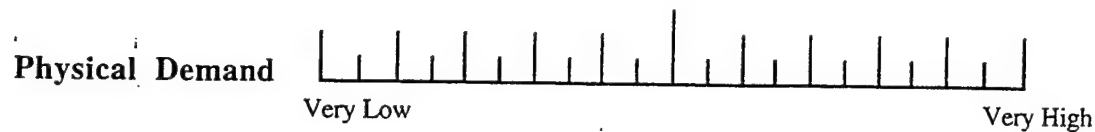
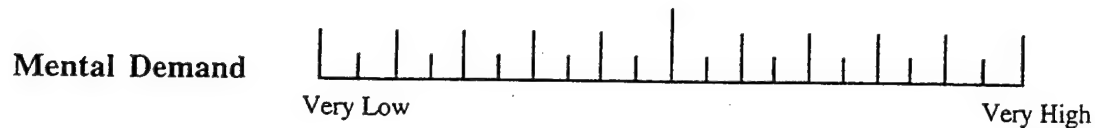
The **temporal demand** scale asks you to rate how much time pressure you felt due to the rate or pace at which the task or task elements occurred. Was the pace slow and leisurely or rapid and frantic? Make this rating on a scale from very low temporal demand to very high temporal demand.

The **performance** scale asks how successful you think you were in accomplishing the goals of the task or situation set by the mission (or yourself). How satisfied were you with your performance in accomplishing these goals? Make this rating on a scale from perfect (successfully accomplished everything) to failure (nothing was successfully accomplished).

The **effort** scale asks you to rate how hard you had to work (mentally and physically) to accomplish your level of performance. Make this rating on a scale from very low effort (not hard at all) to very high effort (very hard).

The **frustration level** scale asks how insecure, discouraged, irritated, stressed, and annoyed versus secure, gratified, content, relaxed, and complacent you felt during the situation that you just experienced. Make this rating on a scale from very low frustration to very high frustration.

Put an "X" on each of the six scales below, at the point that matches best your workload experience for the mission you have just accomplished.



Put an X on the line where it best describes your response.

A2C2 EXPERIMENT

TEAMWORK AND PERFORMANCE: OBSERVER'S RATING FORM

TEAM # _____ DATE _____ OBSERVER _____ TRIAL # _____

Instructions for Teamwork Ratings

Circle a number on the scale accompanying the questions on the following pages so that it best describes the behavior of the team you just observed. Consider each team separately. Try not to compare one team to another. Instead strive to rate the behavior of a team on an absolute scale. To help you perform this absolute rating a brief description of the behavior you should observe for the highest rating on the scale and a brief description of the behavior you should observe for the lowest rating on the scale are provided for each question. Read these guides or anchors carefully and refer to them as you rate the team on each item. Feel free to write comments or explanations for any question.

The ten rating scales or questions for teamwork are organized into six areas. To further help you in your ratings each area is defined below. Please read these definitions carefully.

Team Orientation

Team orientation refers to the commitment team members have and exhibit to working together. It implies that they place the goals and interest of the team ahead of their personal goals. It also refers to the trust each team member has in the other team members, team pride, and esprit de corps.

Communication Behavior

Communication involves the exchange of information between two or more team members in the prescribed manner and by using proper terminology. Often the purpose of communication is to clarify or acknowledge the receipt of information.

Monitoring Behavior

Monitoring refers to observing the activities and performance of other team members. It implies that team members are individually competent and that they may subsequently provide feedback and backup behavior.

Feedback Behavior

Feedback involves the giving, seeking, and receiving of information among members. Giving feedback refers to providing information regarding other member's performance. Seeking feedback refers to requesting input or guidance regarding performance. Receiving feedback refers to accepting positive and negative information regarding performance.

Back-up Behavior

Backup behavior involves assisting the performance of other team members. This implies that team members have an understanding of other member's tasks. It also implies that members are willing to give and seek assistance.

Coordination Behavior

Coordination refers to team members' executing their activities in a timely and integrated manner. It implies that the performance of some team members influence the performance of other team members. This may involve an exchange of information that subsequently influences another member's performance.

Team Orientation

1. To what extent was this team oriented toward teamwork?

1	2	3	4	5	6	7
---	---	---	---	---	---	---

7 Good team orientation could be inferred in a situation where a team member places the goals and interests of the team ahead of personal goals. Also may be evident through the display of trust, team pride, and esprit de corps, and an awareness that teamwork is important.

1 Poor team orientation manifests itself when members place their personal concerns above the team's success (e.g., disregarding or refusing to follow procedures; arguments, quarrels, and open resentment; and becoming upset with a member's performance and either ignoring or harassing that member are evidences of poor team orientation).

2. To what extent were errors caused by selfish individual actions or decisions?

1	2	3	4	5	6	7
---	---	---	---	---	---	---

7 No selfish actions or decisions of a single team member resulted in errors or poor team performance.

1 The selfish actions and/or decisions by a single team member very frequently resulted in errors or poor team performance.

Comments: _____

Communication Behavior

3. To what extent did team members provide relevant information to another team member, in a pro-active way, without that team member having to ask for it?

1	2	3	4	5	6	7
---	---	---	---	---	---	---

7 Team members always provided important information to others without being asked.

1 Team members never provided information to others unless specifically asked.

Comments: _____

Monitoring Behavior

4. To what extent did team members monitor each other's behavior?

1	2	3	4	5	6	7
---	---	---	---	---	---	---

7 Good monitoring occurs when team members consistently observe the performance of the others to ensure the efficiency of the team; members notice and are concerned with the performance of the entire team; one member recognizes when other team members perform correctly; members consistently keep track of other team members' performance.

1 Poor monitoring occurs when team members fail to notice other team members' performance on almost all occasions; members rarely notice when other team members perform correctly or make a mistake.

5. To what extent did team members alert each other to impending decisions and actions?

1	2	3	4	5	6	7
---	---	---	---	---	---	---

7 Team members always alerted each other to impending decisions and actions; supporting information was actively solicited from other team members.

1 Team members did not keep each other informed of impending decisions and actions; compromises to mission safety or mission effectiveness arose when a team member waited for the other to volunteer significant information.

Comments: _____

Feedback Behavior

6. To what extent did team members provide feedback to one another?

1	2	3	4	5	6	7
---	---	---	---	---	---	---

7 Good feedback behavior occurs when team members go over procedures with one another by identifying mistakes and how to correct them; members ask for input regarding mistakes and what needs to be worked on; members are corrected for mistakes and incorporate the suggestions in their procedures.

1 Poor feedback behavior occurs when one or more team members makes sarcastic comments to one or more members when the scenario doesn't go as planned; members resist asking for advice and make guesses on proper procedures; members reject time-saving suggestions offered by other team members.

Comments: _____

Back-up Behavior

7. To what extent did team members anticipate the need to provide assistance to other team members?

1	2	3	4	5	6	7
---	---	---	---	---	---	---

7 Team members consistently anticipated the need to provide assistance to others during critical phases of the mission.

1 Team members never anticipated the need to provide assistance to others during critical phases of the mission; the others always had to ask.

8. Did the team members adjust individual task responsibilities to prevent overload?

1	2	3	4	5	6	7
---	---	---	---	---	---	---

7 Team members were consistently aware of each other's workload buildup and reacted quickly to adjust division of task responsibilities to redistribute workload.

1 Team members were generally unaware of each other's workload buildup; little or no attempt was made to adjust the distribution of task responsibilities before significant compromises to mission safety or mission effectiveness occurred.

Comments: _____

Coordination Behavior

9. To what extent was the team's behavior coordinated?

1	2	3	4	5	6	7
---	---	---	---	---	---	---

7 Good coordination behavior occurs when team members consistently pass critical information to the other members, thereby enabling them to accomplish tasks; members consistently carry out tasks quickly or in a timely manner enabling others to carry out their tasks effectively. Team members appear very familiar with the relevant parts of one another's jobs and carry out individual tasks in a synchronized manner.

1 Poor coordination behavior occurs when team members consistently carry out their tasks ineffectively, leading to other team members' failing at their tasks; members carry out their tasks unpredictably, leading to delays in execution of critical tasks; members neglect to pass on critical pieces of information to one another, leading to breakdowns in team performance; team members carry out their tasks with significant delays leading to team errors.

10. How congruent/similar were the CJTF's and the other team members' understanding of the mission?

1	2	3	4	5	6	7
---	---	---	---	---	---	---

7 Commander and other team members were completely in agreement (i.e., congruent) on goals, tasks, and concepts involving the mission.

1 Commander and other team members were rarely in agreement (i.e., congruent) on goals, tasks, and concepts involving the mission.

Comments: _____

A2C2 EXPERIMENT POST-EXPERIMENT QUESTIONNAIRE

Name _____ Team# _____ Team Position: _____ Date: _____

For half the trials the component (land or maritime) you operated in was a three-tier hierarchical organization where you reported to a CCC or MCC and for the other half the component you operated in was a two-tier flattened organization where you reported directly to the CJTF.

1a) In what condition was the component better able to perform the mission?
 _____ 3-tier _____ 2-tier _____ No Difference

1b) How much better was the team able to perform the mission in that condition?

--	--	--	--	--	--

not much better
midpoint
very much better

2a) In what condition was the coordination better?
 _____ 3-tier _____ 2-tier _____ No Difference

2b) How much better was component coordination in that condition?

--	--	--	--	--	--

not much better
midpoint
very much better

3a) In what condition was communication among component members better/more efficient?
 _____ 3-tier _____ 2-tier _____ No Difference

3b) How much better was communication among component members in that condition?

--	--	--	--	--	--

not much better
midpoint
very much better

4a) In what condition did the CJTF perform his/her function better?
 _____ 3-tier _____ 2-tier _____ No Difference

4b) How much better did the CJTF perform in that condition?

--	--	--	--	--	--

not much better
midpoint
very much better

5a) In what condition did the component develop and use better/more efficient strategies?

_____ 3-tier _____ 2-tier _____ No Difference

5b) How much better were strategies developed and used in that condition?

--	--	--	--	--	--

not much
better

midpoint

very much
better

Opinions and attitudes about the experience

6. Overall, how realistic did you find the scenarios? Realism was:

--	--	--	--	--

very low

midpoint

very high

7. How easy was it to communicate what you intended using the formatted messages?

--	--	--	--	--

extremely easy

midpoint

not easy at all

8. How realistic was it communicating using the formatted messages?

--	--	--	--	--

very low

midpoint

very high

9. How adequate was the simulator's display?

--	--	--	--	--

very low

midpoint

very high

10. How easy was the simulator to use and operate?

--	--	--	--	--

extremely easy

midpoint

not easy at all

11. How adequate was the training for this experiment? Training adequacy was:

--	--	--	--	--

very low

midpoint

very high

12. How enjoyable was the simulator experience?

--	--	--	--	--

very low

midpoint

very high

13. How operationally relevant was the simulation experience?

--	--	--	--	--

very low

midpoint

very high

14. Overall, how worthwhile did you feel this experiment was?

--	--	--	--	--

very low

midpoint

very high

15. How applicable do you feel the results of this experiment will be to problems in the services?

--	--	--	--	--

very low

midpoint

very high

16. Briefly describe how you handled the competition for resources when it occurred.

17. Describe what were the main impediments to good performance for you.

For the team.

18. Describe what you would have liked to have learned during the training sessions to improve your performance.

19. Describe the advantages and disadvantages of operating in a three-tier organization when seeking organic resources.

When seeking inorganic resources.

20. Describe any general comments you have about the experiment.

Thank you!


A2C2 EXPERIMENT POST-TRIAL QUESTIONNAIRE


NAME: _____ TEAM POSITION: _____


TEAM #: _____ DATE: _____


These questions pertain to the specific trial and scenario you just completed. Please complete this questionnaire independent of other team members.


Put an "X" on each of the six scales below, at the point that matches best your workload experience for the mission you have just accomplished.


Mental Demand 
Very Low Very High

Physical Demand 
Very Low Very High

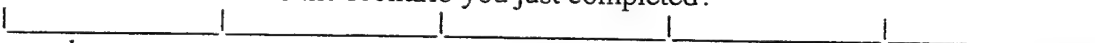
**Temporal Demand
(Time Pressure)** 
Very Low Very High

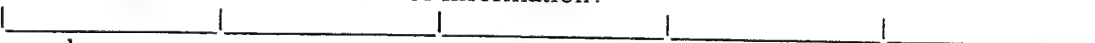
Performance 
Perfect Failure

Effort 
Very Low Very High

Frustration 
Very Low Very High

Put an X on the line where it best describes your response.

1. How realistic was the scenario you just completed?

 very low midpoint very high

2. How effective was the flow of information?

 very low midpoint very high

3. How effective was the movement of resources?
 |-----|-----|-----|-----|
 very low midpoint very high
4. How long did it take you to come to a good understanding of the tasks you had to perform?
 |-----|-----|-----|-----|
 very short midpoint very long
 time time
5. How slow or fast was the flow of information?
 |-----|-----|-----|-----|
 very slow midpoint very fast
6. How slow or fast was the transfer of resources?
 |-----|-----|-----|-----|
 very slow midpoint very fast
7. How easy or difficult was it to seek and obtain information?
 |-----|-----|-----|-----|
 very easy midpoint very difficult
8. On average, how much time did you spend communicating with other team members (for the scenario trial just completed)?
 |-----|-----|-----|-----|
 very little midpoint a great deal
9. How long did it take you to decide on a course of action to cope with the various occurrence during this scenario?
 |-----|-----|-----|-----|
 very short midpoint very long
 time time
10. How well did you coordinate your actions with the rest of the team?
 |-----|-----|-----|-----|
 not very midpoint extremely
 well at all well
11. How well did you coordinate resource utilization with other team members?
 |-----|-----|-----|-----|
 not very midpoint extremely
 well at all well
12. Which team position was the most critical to performing the mission? (Circle one)
 CJTF GCC/MCC CVBG ARG MEU 1 MEU 2
13. Which team position experienced the highest work load? (Circle one)
 CJTF GCC/MCC CVBG ARG MEU 1 MEU 2

NAME _____ TEAM# _____ DATE _____ TRIAL# _____

CURRENT AND FUTURE PRIORITY OF TASKS AND ASSETS

- 1.) Please put a check mark next to the team position you are playing.
- 2.) Use the list of TASKS below. Select the CURRENT top two priority tasks for YOU by placing the appropriate letter preceding the tasks under First and Second for the two highest priority tasks in order.
- 3.) Repeat this for all the OTHER TEAM POSITIONS, each time indicating the top two priority tasks confronting that team position. For what you do not know put a ? mark.
- 4.) Use the list of ASSETS below. Select the CURRENT top two priority asset YOU will need by placing the appropriate number preceding the asset under First and Second for the two highest priority assets in order.
- 5.) Repeat this for all the OTHER TEAM POSITIONS, each time indicating the top two priority assets that will be needed by that team position. For what you do not know put a ? mark.
- 6.) Repeat this procedure for the highest priority task that YOU and each of the OTHER TEAM POSITIONS will confront in the FUTURE and for the highest priority assets that you and each of the other team positions will need in the FUTURE.

	PRESENT				FUTURE	
	Priority Tasks		Priority of Assets		Top Priority Task	Top Priority Assets
	First	Second	First	Second	First	First
Team Position						
CJTF						
GCC/MCC						
CVBG						
ARG						
MEU 1						
MEU 2						

TASKS

a__AAW
 b__Move Force
 c__Artillery Suppression
 d__ASUW
 e__ASW
 f__Frog Suppression
 g__Final Objective
 h__Id Silkworm
 i__Kill Hind Helo
 j__Kill Patrol Boats
 k__Kill Silkworm
 l__Kill Tanks on Road
 m__Medevac
 n__Mine Clearance/ Ashore
 o__Mine Clearance/ Beach
 p__Reinforce Attack
 q__Take Air Field
 r__Take Port
 s__Other (specify)
 t__Unknown

ASSETS

1__CG
 2__Cobras
 3__DD
 4__Engineer Plt
 5__F/A-18 (CAS)
 6__F-14 (CAP)
 7__F-15 (CAP)
 8__FFG
 9__MCM Helo
 10__Medevac Helo
 11__NSFS
 12__Reserve Co
 13__SH-60
 14__SR-71
 15__Stinger Plt

APPENDIX D

NAME: _____ TEAM #: _____ DATE: _____

Observer Form for Rating Competition over Assets MODULE 1

(MEUs compete for organic assets)

For each task place check on appropriate line to indicate how competition was resolved. Also note time.

TASK 1 — KILL TANKS ON NORTH/SOUTH ROADS

Competition for Cobras (check one and mark time resolved)

OBSERVATION: How was competition resolved?

- | | |
|---|----|
| 1) MEU 1 gives Cobras to MEU 2 in response to MEU 2's request. | 25 |
| 2) MEU 1 gives Cobras to MEU 2 on own volition, after noticing that MEU 2 has priority. | 30 |
| 3) MEU 1 keeps Cobras in spite of MEU 2's request, Sr. Cdr. intervenes and gives them to MEU 2. | 15 |
| 4) MEU 1 keeps Cobras in the absence of MEU 2's request, Sr. Cdr. intervenes and gives them to MEU 2. | 20 |
| 5) MEU 1 keeps Cobras in spite of MEU 2's request, Sr. Cdr. does not intervene. | 1 |
| 6) MEU 1 keeps Cobras in the absence of MEU 2's request, Sr. Cdr. does not intervene. | 9 |
| 7) Other: (specify how) _____ | |

TASK 2 — CONDUCT MEDEVAC

Competition for MEDEVAC.

OBSERVATION: How was competition resolved?

- | | |
|--|----|
| 1) MEU 2 gives MEDEVAC to MEU 1 in response to MEU 1's request. | 25 |
| 2) MEU 2 gives MEDEVAC to MEU 1 on own volition, after noticing that MEU 1 has priority. | 30 |
| 3) MEU 2 keeps MEDEVAC in spite of MEU 1's request, Sr. Cdr. intervenes and gives it to MEU 1. | 15 |
| 4) MEU 2 keeps MEDEVAC in the absence of MEU 1's request, Sr. Cdr. intervenes and gives it to MEU 1. | 20 |
| 5) MEU 2 keeps MEDEVAC in spite of MEU 1's request, Sr. Cdr. does not intervene. | 1 |
| 6) MEU 2 keeps MEDEVAC in the absence of MEU 1's request, Sr. Cdr. does not intervene. | 9 |
| 7) Other: (specify how) _____ | |

TASK 3 — CLEAR MINES

Competition for engineer platoon.

OBSERVATION: How was competition resolved?

- | | |
|--|----|
| 1) MEU 1 gives Engineers to MEU 2 in response to MEU 2's request. | 25 |
| 2) MEU 1 gives Engineers to MEU 2 on own volition, after noticing that MEU 2 has priority. | 30 |
| 3) MEU 1 keeps Engineers in spite of MEU 2's request, Sr. Cdr. intervenes and gives them to MEU 2. | 15 |
| 4) MEU 1 keeps Engineers in the absence of MEU 2's request, Sr. Cdr. intervenes and gives them to MEU 2. | 20 |
| 5) MEU 1 keeps Engineers in spite of MEU 2's request, Sr. Cdr. does not intervene. | 1 |
| 6) MEU 1 keeps Engineers in the absence of MEU 2's request, Sr. Cdr. does not intervene. | 9 |
| 7) Other: (specify how) _____ | |

NAME: _____ TEAM #: _____ DATE: _____

Observer Form for Rating Competition over Assets
MODULE 3 (SEA UNITS)
 (Sea-based units compete for organic assets)

For each task place check on appropriate line to indicate how competition was resolved. Also note time.

TASK 1 — PERFORM ASW

Time Occurs _____

Competition for FFG

OBSERVATION: How was competition resolved?

- | | | |
|---|-------|----|
| 1) CVBG gives FFG to ARG in response to ARG's request. | _____ | 25 |
| 2) CVBG gives FFG to ARG on its own volition, after noticing ARG has priority. | _____ | 30 |
| 3) CVBG keeps FFG in spite of ARG's request, Sr. Cdr. intervenes and gives it to ARG. | _____ | 15 |
| 4) CVBG keeps FFG in the absence of ARG's request, Sr. Cdr. intervenes and gives it to ARG. | _____ | 20 |
| 5) CVBG keeps FFG in spite of ARG's request, Sr. Cdr. does not intervene. | _____ | 1 |
| 6) CVBG keeps FFG in the absence of ARG's request, Sr. Cdr. does not intervene. | _____ | 9 |
| 7) Other: (specify how) _____ | _____ | |

TASK 2 — PERFORM AAW W/ STINGER PLATOON

Time Occurs _____

Competition for STINGER PLATOON.

OBSERVATION: How was competition resolved?

- | | | |
|--|-------|----|
| 1) ARG gives Stinger Platoon to CVBG in response to CVBG's request | _____ | 25 |
| 2) ARG gives Stinger Platoon to CVBG on its own volition, after noticing that CVBG has priority. | _____ | 30 |
| 3) ARG keeps Stinger Platoon in spite of CVBG's request, Sr. Cdr. intervenes and gives it to CVBG. | _____ | 15 |
| 4) ARG keeps Stinger Platoon in the absence of CVBG's request, Sr. Cdr. intervenes and gives it to CVBG. | _____ | 20 |
| 5) ARG keeps Stinger Platoon in spite of CVBG's request, Sr. Cdr. does not intervene. | _____ | 1 |
| 6) ARG keeps Stinger Platoon in the absence of CVBG's request, Sr. Cdr. does not intervene. | _____ | 9 |
| 7) Other: (specify how) _____ | _____ | |

TASK 3 — PERFORM AAW W/ AEGIS Cruiser.

Time Occurs _____

Competition over AEGIS Cruiser.

OBSERVATION: How was competition resolved?

- | | | |
|--|-------|----|
| 1) CVBG gives AEGIS CV to ARG in response to ARG's request. | _____ | 25 |
| 2) CVBG gives AEGIS CV to ARG on its own volition, after noticing that ARG has priority | _____ | 30 |
| 3) CVBG keeps AEGIS CV in spite of ARG's request, Sr. Cdr. Intervenes and gives it to ARG. | _____ | 15 |
| 4) CVBG keeps AEGIS CV in the absence of ARG's request, Sr. Cdr. intervenes and gives it to ARG. | _____ | 20 |
| 5) CVBG keeps AEGIS CV in spite of ARG's request, Sr. Cdr. does not intervene. | _____ | 1 |
| 6) CVBG keeps AEGIS in the absence of ARG's request, Sr. Cdr. does not intervene. | _____ | 9 |
| 7) Other: (specify how) _____ | _____ | |

NAME: _____ TEAM #: _____ DATE: _____

**Observer Form for Rating Competition over Assets
MODULE 2**

(MEUs compete for non-organic assets)

For each task place check on appropriate line to indicate how competition was resolved. Also note time.

TASK 1 — CLEAR MINES FROM BEACH.

Time Occurs _____

Competition for Mineclearing Helicopter (check one and mark time resolved)

OBSERVATION: How was competition resolved?

- | | |
|---|----|
| 1) MEU 1 requested MCM Helos first, got them first and used them first. | 6 |
| 2) MEU 1 requested MCM Helos first, got them and gave them to MEU 2 in response to MEU 2's request. | 27 |
| 3) MEU 1 requested MCM Helos first, but Sr. CDR gave them to MEU 2 instead. | 32 |
| 4) MEU 2 requested MCM Helos first, got them and used them first. | 32 |
| 5) MEU 2 requested MCM Helos first, got them and gave them to MEU 1 in response to MEU 1's request. | 2 |
| 6) MEU 2 requested MCM Helos first, but Sr. CDR gave them to MEU 1 instead. | 1 |
| 7) Other (specify how) _____ | |

TASK 2 — KILL POP-UP FROG LAUNCHER with CAS.

Time Occurs _____

Competition for CAS

OBSERVATION: How was competition resolved?

- | | |
|---|----|
| 1) MEU 1 requested CAS first, got it first and used it first. | 6 |
| 2) MEU 1 requested CAS first, got it and gave it to MEU 2 in response to MEU 2's request. | 27 |
| 3) MEU 1 requested CAS first, but Sr. CDR gave it to MEU 2 instead. | 32 |
| 4) MEU 2 requested CAS first, got it and used it first. | 32 |
| 5) MEU 2 requested CAS first, got it and gave it to MEU 1 in response to MEU 1's request. | 2 |
| 6) MEU 2 requested CAS first, but Sr. CDR gave it to MEU 1 instead. | 1 |
| 7) Other (specify how) _____ | |

TASK 3 — REINFORCE AIRFIELD/PORT ATTACK.

Time Occurs _____

Competition for Reserve Company.

OBSERVATION: How was competition resolved?

- | | |
|---|----|
| 1) MEU 1 requested Reserve Company first, got it first and used it first. | 6 |
| 2) MEU 1 requested Reserve Company first, got it and gave it to MEU 2 in response to MEU 2's request. | 27 |
| 3) MEU 1 requested Reserve Company first, but Sr. CDR gave it to MEU 2 instead. | 32 |
| 4) MEU 2 requested Reserve Company first, got it and used it first. | 32 |
| 5) MEU 2 requested Reserve Company first, got it and gave it to MEU 1 in response to MEU 1's request. | 2 |
| 6) MEU 2 requested Reserve Company first, but Sr. CDR gave it to MEU 1 instead. | 1 |
| 7) Other (specify how) _____ | |

TASK 4 — STRIKE SILKWORM SITE.

Competition over CAS.

OBSERVATION: How was competition resolved?

- | | | |
|---|-------|----|
| 1) CVBG requested CAS first, got it and used it first | _____ | 32 |
| 2) CVBG requested CAS first, got it and gave it to ARG in response to ARG's request. | _____ | 2 |
| 3) CVBG requested CAS first, but higher HQ gave it to ARG instead | _____ | 1 |
| 4) ARG requested CAS first, got it and used it first. | _____ | 6 |
| 5) ARG requested CAS first, got it and gave it to CVBG in response to CVBG's request. | _____ | 27 |
| 6) ARG requested CAS first, but higher HQ gave it to CVBG instead. | _____ | 32 |
| 7) Other: (specify how)_____ | _____ | |

NAME: _____ TEAM #: _____ DATE: _____

Observer Form for Rating Competition over Assets
MODULE 4 (SEA UNITS)
 (Sea-based units compete for non-organic assets)

For each task place check on appropriate line to indicate how competition was resolved. Also note time.

TASK 1 — Kill Patrol Boats w/ SH-60s.

Time Occurs _____

Competition over SH-60s.

OBSERVATION: How was competition resolved?

- | | |
|--|----------|
| 1) CVBG requested SH-60s first, got them and used them first. | _____ 6 |
| 2) CVBG requested SH-60s first, got them and gave them to ARG in response to ARG's request. | _____ 27 |
| 3) CVBG requested SH-60s first, but higher HQ gave them to ARG instead. | _____ 32 |
| 4) ARG requested SH-60s first, got them and used them first | _____ 32 |
| 5) ARG requested SH-60s first, got them and gave them to CVBG in response to CVBG's request. | _____ 2 |
| 6) ARG requested SH-60s first, but higher HQ gave them to CVBG instead | _____ 1 |
| 7) Other: (specify how) _____ | _____ |

TASK 2 — Positively ID Silkworm sites.

Competition over SR-71s.

OBSERVATION: How was competition resolved?

- | | |
|--|----------|
| 1) CVBG requested SR-71s first, got them and used them first | _____ 32 |
| 2) CVBG requested SR-71s first, got them and gave them to ARG in response to ARG's request. | _____ 2 |
| 3) CVBG requested SR-71s first, but higher HQ gave them to ARG instead | _____ 1 |
| 4) ARG requested SR-71s first, got them and used them first | _____ 6 |
| 5) ARG requested SR-71s first, got them and gave them to CVBG in response to CVBG's request. | _____ 27 |
| 6) ARG requested SR-71s first, but higher HQ gave them to CVBG instead. | _____ 32 |
| 7) Other: (specify how) _____ | _____ |

TASK 3 — MAINTAIN CAP OVER ARG.

Competition over CAP.

OBSERVATION: How was competition resolved?

- | | |
|--|----------|
| 1) CVBG requested CAP first, got it and used it first. | _____ 6 |
| 2) CVBG requested CAP first, got it and gave it to ARG in response to ARG's request. | _____ 27 |
| 3) CVBG requested CAP first, but higher HQ gave it to ARG instead. | _____ 32 |
| 4) ARG requested CAP first, got it and used it first. | _____ 32 |
| 5) ARG requested CAP first, got it and gave it to CVBG in response to CVBG's request | _____ 2 |
| 6) ARG requested CAP first, but higher HQ gave them to CVBG instead | _____ 1 |
| 7) Other: (specify how) _____ | _____ |

TASK 4 — MAINTIAN CAP over ARG.

Competition for CAP.

OBSERVATION: How was competition resolved?

1) CVBG gives CAP to ARG in response to ARG's request.	_____	_____	25
2) CVBG gives CAP to ARG of its own volition, after noticing that ARG has priority.	_____	_____	30
3) CVBG keeps CAP in spite of ARG's request, Sr. Cdr. intervenes and gives it to ARG.	_____	_____	15
4) CVBG keeps CAP in the absence of ARG's request, Sr. Cdr. intervenes and gives it to ARG.	_____	_____	20
5) CVBG keeps CAP in spite of ARG's request, Sr. Cdr. does not intervene.	_____	_____	1
6) CVBG keeps CAP in the absence of ARG's request, Sr. Cdr. does not intervene.	_____	_____	9
7) Other: (specify how) _____	_____	_____	

APPENDIX C: DATA TABLES

The following spreadsheets are the product of the data reduction in Chapter III.

The first page contains the following columns:

Task Str:	1 = Organic competition tasks 2 = Non-organic competition tasks
Org Str:	2 = Two-tier organization structure 3 = Three-tier organization structure
Componen:	1 = Ground component commander (GCC) 2 = Maritime component commander (MCC)
COMPFACT:	(5*Task Str + Org Str) used for Kruskal-Wallis Test
Wcompetit:	Weighted competition score
Rcompetit:	Ranked competition score
AvgLaten:	Average Latency

The second page contains the following columns:

GCC/MCC:	1 = Ground Component Commander 2 = Maritime Component Commander
Org/Norg:	1 = Organic task structure 2 = Non-organic task structure
Mission:	Mission Score
Strength:	Unadjusted strength score
AdjStrength:	Adjusted Strength score

Task Str	Org Str	Componen t	COMPFACT	WCompetit	RCompetit	AvgLaten
1	2	1	7	25	5	536.68
1	3	2	8	22.25	4.5	232.8
2	3	1	13	22.67	4.67	690.22
2	2	2	12	19	4.5	312.1
1	3	1	8	1	1	529.19
1	2	2	7	21	4.25	240.6
2	2	1	12	32	6	568.1
2	3	2	13	25	5	447.28
1	2	1	7	19.67	4	296.45
1	3	2	8	11	2.33	205.15
2	3	1	13	14.67	4	425.07
2	2	2	12	23.25	4.5	206.95
1	3	1	8	21.33	4.33	274.443
1	2	2	7	14.25	3	172.5
2	2	1	12	23.33	5	293.4
2	3	2	13	23.33	5	397.45
1	2	1	7	15.5	3.5	283.04
1	3	2	8	22.75	4.75	131.9
2	3	1	13	32	6	375.51
2	2	2	12	26.5	4.75	192.95
1	3	1	8	9	2	447.12
1	2	2	7	18.25	3.75	141.15
2	2	1	12	13	3.5	323.35
2	3	2	13	21.67	4.33	372.776
1	2	1	7	27.5	5.5	287.34
1	3	2	8	18.25	3.75	162.6
2	3	1	13	23.33	5	253.72
2	2	2	12	26.33	5	194.3
1	3	1	8	28.33	5.67	294.46
1	2	2	7	25	5	208.1
2	2	1	12	32	6	423.02
2	3	2	13	19	4.5	402.2

GCC/MCC	Org/NOrg	Mission	Strength	AdjStrength
2	1	100	74	85
*	*	*	*	*
1	2	91	88	88
*	*	*	*	*
1	1	78	74	85
*	*	*	*	*
2	2	100	100	100
*	*	*	*	*
2	1	100	85	96
*	*	*	*	*
1	2	100	93	93
*	*	*	*	*
1	1	100	75	86
*	*	*	*	*
2	2	91	94	94
*	*	*	*	*
2	1	100	89	100
*	*	*	*	*
1	2	100	100	100
*	*	*	*	*
1	1	100	79	90
*	*	*	*	*
2	2	100	100	100
*	*	*	*	*
2	1	100	96	100
*	*	*	*	*
1	2	100	100	100
*	*	*	*	*
1	1	100	89	100
*	*	*	*	*
2	2	100	100	100

The following data tables contain the latency times the tasks indicated below. The values are broken out by team, task type, task number, and organization structure. The "BIN" column is the binary value (1 = True, 0 = False) for the condition (Three-Tier < Two-Tier). The sum of the BIN values for all teams in a specific task type (ground or maritime) are used for the binomial non-parametric test. The task numbers are translated below and refer to the flow charts of the scenarios in Appendix C.

Organic Tasks

<u>Number</u>	<u>Description</u>
1	Medevac on Blue Beach
2	Medevac on Red Beach
3	Kill Tanks on South Road
4	Kill Tanks on North Road
5	Clear Mines, South Road
6	Clear Mines, North Road
7	Perform ASW (CVBG)
8	Perform ASW (ARG)
9	Perform AAW with Stinger Platoon (CVBG)
10	Perform AAW with Stinger Platoon (ARG)
11	Perform AAW with AEGIS Cruiser (CVBG)
12	Perform AAW with AEGIS Cruiser (ARG)

Non-organic Tasks

<u>Number</u>	<u>Description</u>
1, 2, 3	Clear Mines from Blue Beach
4, 5, 6	Clear Mines from Red Beach

- 7 Kill Pop-up Frog Launcher with CAS (MEU2)
- 8 Kill Pop-up Frog Launcher with CAS (MEU1)
- 9, 11 Kill Patrol Boats with SH-60 Helos (ARG)
- 10, 12 Kill Patrol Boats with SH-60 Helos (CVBG)
- 13 Strike Silkworm Site (CVBG)
- 14 Strike Silkworm Site (ARG)

GROUND ORGANIC

Team A			
Task Type	3-Tier	2-Tier	BIN
1	734	701.5	0
2	1598.5	1356	0
3	1118.5	1179	1
4	618.5	640.5	1
5	2400	2400	0
6	2400	778	0

Team B			
Task Type	3-Tier	2-Tier	BIN
1	406	436.5	1
2	476	608.5	1
3	492.5	421.5	0
4	568.5	519	0
5	714	711	0
6	813.5	841.5	1

Team C			
Task Type	3-Tier	2-Tier	BIN
1	860	541	0
2	949.5	656.5	0
3	877.5	460	0
4	776.5	346.5	0
5	1374.5	671.5	0
6	1623	973.5	0

Team D			
Task Type	3-Tier	2-Tier	BIN
1	689	751.5	1
2	586.5	441	0
3	503	460.5	0
4	578	532.5	0
5	784.5	690.5	0
6	909.5	858.8	0

MARITIME ORGANIC

Team A			
Task Type	3-Tier	2-Tier	BIN
7	562	531.5	0
8	260.5	307	1
9	920.5	869	0
10	755.5	851	1
11	963.5	1065	1
12	1062	1023.5	0

Team B			
Task Type	3-Tier	2-Tier	BIN
7	217	240	1
8	393.5	405	1
9	918	2400	1
10	703.5	855.5	1
11	2400	1029.5	0
12	1014	2400	1

Team C			
Task Type	3-Tier	2-Tier	BIN
7	273	295	1
8	161.5	155	0
9	2400	2400	0
10	847.5	852	1
11	986.5	963	0
12	1008	2400	1

Team D			
Task Type	3-Tier	2-Tier	BIN
7	263	295	1
8	428	481.5	1
9	847.5	2400	1
10	857	854.5	0
11	981.5	936.5	0
12	1010.5	1000	0

GROUND NON-ORGANIC

Team A				Team B			
Task Type	3-Tier	2-Tier	BIN	Task Type	3-Tier	2-Tier	BIN
1	243.5	300	1	1	230.5	202.5	0
2	2400	280.5	0	2	250	220.5	0
3	263.5	263.5	0	3	269.5	238	0
4	539	587	1	4	360.5	378.5	1
5	557	609	1	5	341.5	344.5	1
6	581	632.5	1	6	322	310.5	0
7	1506.5	1239.5	0	7	1520.5	1107	0
8	1850	1765.5	0	8	1535.5	1006	0

Team C				Team D			
Task Type	3-Tier	2-Tier	BIN	Task Type	3-Tier	2-Tier	BIN
1	384.5	338	0	1	191.5	301.5	1
2	358.5	323.5	0	2	175.5	281.5	1
3	335.5	306.5	0	3	159.5	246.5	1
4	472.5	231	0	4	299.5	426.5	1
5	488.5	210.5	0	5	250.5	398	1
6	506	247.5	0	6	275.5	379	1
7	769	971	1	7	933	1054.5	1
8	857	867	1	8	768	1162	1

MARITIME NON-ORGANIC

Team A				Team B			
Task Type	3-Tier	2-Tier	BIN	Task Type	3-Tier	2-Tier	BIN
9	1154.5	1253	1	9	1130.5	1080.5	0
10	946	932.5	0	10	969.5	930.5	0
11	2277.5	2059.5	0	11	2398.5	2046	0
12	2083.5	2212	1	12	2245.5	2195	0
13	1319.5	1547.5	1	13	1329	1269	0
14	1588.5	1654	1	14	1462.5	1677.5	1

Team C				Team D			
Task Type	3-Tier	2-Tier	BIN	Task Type	3-Tier	2-Tier	BIN
9	1083	1072	0	9	869.5	895.5	1
10	890	890	0	10	1018.5	1053	1
11	2280.5	2285.5	1	11	2363.5	2031	0
12	2104	2088.5	0	12	2085.5	2100.5	1
13	1273	1494.5	1	13	1277.5	1315.5	1
14	1421	1321	0	14	1520	1475.5	0

APPENDIX D: DDD-III/AWK TUTORIAL

The following tutorial provides the user with the necessary codes and AWK programs for analyzing the initial A2C2 experiment. It is also intended to provide a framework for further analysis of DDD-III (or later version) log files. The codes used as inputs to the AWK programs herein are specific to the initial A2C2 experiment only, but the AWK programs can be tailored for any DDD-III output.

A. LOG FILE PROTOCOLS

The log files generated by the DDD-III simulation contain records of all actions taken by subjects during the course of an experimental trial. It is important to understand how these records are generated and stored.

Each player action is stored as a "record" in the log file. Records are separated by asterisks (*), and contain all of the information necessary to describe an action. Each record is different, depending upon the type of action that was performed. For instance, records that deal with information transfer are formatted differently than records of communication between subjects.

The information contained in the records are stored in "fields." Each field contains one, possibly multi-digit, number or contiguous text. Fields are separated by spaces and end-of-line characters. The number of fields in each record is different for each record type. This information is important when determining search parameters for AWK programs.

B. DATA CODES

There are many different types of numerical codes contained in each DDD-III record. Only those codes associated with mission thread analysis will be discussed. The clever researcher can determine other possibly useful codes from the ones presented below.

1. Action Codes

Action codes are four digit numerical codes used to describe player actions such as movement, attacks, information transfer, and asset transfers. All of the codes used in the DDD-III simulation for the initial A2C2 experiment are presented below. The format used is: the name of the code (ALL CAPS), the numerical equivalent, the syntax in text form, and definitions of each field name. The first line of every syntax contains the following fields: *dm ##### current time*. The *dm* is the subject or player (*decision maker*) who performed the action. *#####* is the numerical code associated with the action performed. The *current time* is the time in the simulation when the action occurred.

ASSET_MOVE 2005

dm 2005 current time
Platform_ID x y vx vy T xt yt

Platform_ID : ID number of the platform used to perform the task
x, y : current (x, y) coordinates
vx, vy : commanded velocity in (x, y) directions
T : time that the move will take to complete
xt, yt : commanded terminal (x, y) coordinates

Example:

```
*  
4 2005 22.500000  
1 0.879005 0.539926 -0.001990 -0.000148 145.000000 0.591429 0.518571  
*
```

ASSET_PURSUIT

2006

dm 2006 current time

Platform_ID Task_ID flag x y vx vy

Platform_ID : ID number of the platform used to perform the task

Task_ID : ID number of the task being pursued

flag : unknown

x, y : current (x, y) coordinates of pursuing platform

vx, vy : commanded pursuit velocity in (x, y) directions

Example:

*

4 2006 2095.500000

130 302 1 0.467163 0.319383 -0.003903 -0.000756

*

ASSET_RETURN

2007

dm 2007 current time

Platform_ID flag refuel time

Platform_ID : ID number of the platform being returned

flag : unknown

refuel time : time delay prior to platform being available again

Example:

*

1 2007 571.000000

101 1 41.436962

*

ASSET_TRANSFER 2009

dm 2009 current time

Platform_ID old_owner new_owner flag

Platform_ID : ID number of the platform being transferred

old_owner : person transferring platform

new_owner : person receiving platform

flag : 0 - voluntary transfer

3 - forced transfer

Example:

*

0 2009 138.500000

101 0 3 0

*

ATTACKING 2010

dm 2009 current time

Platform_ID#1 Platform_ID#2 Platform_ID#3

totres1 totres2 ... totresN

Task_ID dm time_delay expertise

flag

Platform_ID#I : ID # of the *i*th platform in the attack (999 is just a space holder)

totresi : total amount of resource *i* in the attacking asset set

Task_ID : number of the task being attacked

dm# : The ID # of the player who conducted the attack

time_delay : time it takes for an attack to be completed

expertise : 1 for a normal attack

0 for an improper attack

flag : Not Used

Example:

*

3 2010 249.500000

101 999 999

0 0 0 0 2 0 0 0 0 0 0 0 0 0 0 0 0 0

238 3 10.000000 1.000000

3

*

LAUNCH_SUB

2011

dm 2011 current time

Platform_ID subplatform_class number_of_subplatform launch_delay

Platform_ID : ID # of the parent platform

subplatform_class : which parent relative class to launch

number_of_subplatform : number of subplatforms to launch

launch_delay : time to complete a launch

Example:

*

0 2011 8.000000

10 1 1 30.000000

*

REFUSE

2012

dm 2012 current time

message_ref dm

Platform_ID#1 Platform_ID#2 Platform_ID#3

message_ref : ID # of the message being refused

dm : person whose command is being refused

Platform_ID*i* : ID # of platforms whose state will be unlocked (999 is a space holder)

Example: None Available

INFO_TRANSFER

2013

dm 2013 current time

dm todm Task_ID classid confidence

attr#1 attr#2 ... attr#N

dm : player who sent the information

todm : player(s) who received the information (30 is all players)

Task_ID : ID # of the relevant task

classid, confidence : the class identification and confidence sent by dm

attr#*i* : task attribute values sent from "dm" to "todm"

Example:

*

0 2013 27.500000

0 30 210 21 3.000000

2.000000 10.000000 0.000000 0.000000 20.000000 0.000000 0.000000 0.000000

0.000000 999.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000

0.000000 0.000000 0.000000 0.000000

1

*

SEND_MESSAGE

2014

dm 2014 current time

dm todm (kind)

complete message text string

dm : player who sent the message

todm : player who received the message

kind :

MSG_IPLAN_HANDLE	3000
MSG_IPLAN_SUPPORT	3001
MSG_CANNOT_HANDLE	3002
MSG_CANNOT_SUPPORT	3003
MSG_CANYOU_HANDLE	3004
MSG_CANYOU_SUPPORT	3005
MSG_IPLAN_ATTACK	3006
MSG_CANNOT_ATTACK	3007
MSG_CANYOU_ATTACK	3008
MSG_REQ_PLATFORM	3009
MSG_REQ_LAUNCH	3010
MSG_REQ_INFO	3011
MSG_CANNOT_XFR	3012
MSG_TOBE_DEFINED	3013
ECHO_TO_BOSS	3014

Example:

*

0 2014 162.500000

0 5 (3009)

02:42: From CJTF: Please XFR 'FFG-002' at (76.37,43.79) to CJTF (Priority :High)

*

DSS

2015

dm 2015 current time
dm task_id
attr#1 attr#2 ... attr#N
res#1 res#2 ... res#N

attr#N : attributes sent
res#N : resources sent

Example:

```
*
1 2015 258.500000
1 308
999.000000 999.000000 999.000000 999.000000 999.000000 999.000000 999.000000
999.000000 999.000000 999.000000 0.000000 0.000000 0.000000 0.000000 0.000000
0.000000 0.000000 0.000000 0.000000 0.000000
0.000000 0.000000 10.000000 10.000000 0.000000 0.000000 0.000000 0.000000
0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000
0.000000 0.000000 0.000000
```

*

POSITION

2016

dm 2016 current time
Platform_ID x y

Platform_ID : ID # of relevant platform
x, y : (x, y) coordinates at which to position the platform

Example: None Available

ASSIGN_TASK

2017

dm 2017 current time
Task_ID priority
dm#0 dm#1 ... dm#N

Task_ID : ID # of relevant task
priority : the priority of the task
dm#i : 1 if dm#i is assigned to the task

```
*  
0 2017 900.500000  
301 3  
1 0 0 0 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0  
*
```

dm 2018 current time
Task_ID col_type zone Platform_ID

Example:

*
1 2018 957.500000
271 1 6 -1
*

Task identification codes (Task_IDs) for each scenario are found in the scenario generator files. The information required to obtain a full description of a Task_ID is contained in two places, the *Task Class Information* section, the *State Information* section. The *Task Class Information* section defines the task class and lists all of the attributes associated with that task, including what icon, if any, is used to represent the task on the screen. The *State Information* section maps the Task_ID number to a specific

task class. Information in the beginning of each of the previous sections provides a definition of all of the fields.

The Task_ID numbers, task class, and a description for each Task_ID, specific to the A2C2 Initial Experiment are provided below.

Competition for Organic Asset (Scenarios 13GCC/13MCC)

<u>Task_ID</u>	<u>Class</u>	<u>Description</u>
200 -225	21	Swamp
236	9	Sea Mines
237	9	Sea Mines
238	9	Sea Mines
241 -250	5	Artillery
256	8	Land Mines
257	8	Land Mines
261	10	Air (Sea Attack)
262	10	Air (Sea Attack)
271	12	Helicopter
272	12	Helicopter
276	13	Air (Neutral)
281	6	Frog Launcher
286	7	Silkworm Launcher
289	22	Silkworm (launched)
296	17	Submarine
297	17	Submarine
301	16	Patrol Boat
302	16	Patrol Boat
306	0	Hill
307	2	Port
308	1	Airport
309	4	Take
310	4	Take
311	3	Hold
320	14	Tank
321	14	Tank
325	19	Ship (Neutral)
335	20	Medevac
336	20	Medevac

Competition for Non-Organic Assets (Scenarios 24GCC/24MCC)

<u>Task ID</u>	<u>Class</u>	<u>Description</u>
200 -225	21	Swamp
235	9	Sea Mines
236	9	Sea Mines
237	9	Sea Mines
238	9	Sea Mines
239	9	Sea Mines
240	9	Sea Mines
241 -250	5	Artillery
256	8	Land Mines
257	8	Land Mines
261	10	Air (Sea Attack)
271	12	Helicopter
281	6	Frog Launcher
282	6	Frog Launcher
286	7	Silkworm Launcher
287	7	Silkworm Launcher
289	22	Silkworm (launched)
290	22	Silkworm (launched)
296	17	Submarine
301	16	Patrol Boat
302	16	Patrol Boat
303	16	Patrol Boat
304	16	Patrol Boat
306	0	Hill
307	2	Port
308	1	Airport
309	4	Take
310	4	Take
311	3	Hold
315	20	Medevac
320	14	Tank
326	19	Ship (Neutral)
335	8	Ground Mines

3. Platform Identification Codes

The platform identification codes (Platform_IDs) encountered in the log files do not map to a specific platform or platform class. These numbers are assigned by the

DDD-III sequentially as the platforms appear in the scenario. The Platform_IDs are either one- or three-digit numbers, depending on whether the platform in question is a primary platform (FFG for example) or a subplatform that has been launched from a primary platform (Medevac Helos).

Information is available on the platform classes. This is used to look for communications relating to specific platforms in the log files. The platform classes and descriptions are provided below.

<u>Platform Class</u>	<u>Description</u>
VF	Air superiority fighter asset (carrier based)
F15	Air superiority fighter asset (land based)
VA	Air ground attack asset (carrier based)
MCM	Mine countermeasures helicopter
H60	Sea surface attack helicopter
HCB	Cobra attack helicopters
HTP	Heliborne troop company
HMV	Medevac helicopters
HE	Heliborne combat engineer platoon
SR7	SR-7 reconnaissance aircraft
SAM	Surface-to-Air missile
5I	Five inch naval surface fire support mission
SD	Stinger missile detachment
FFG	Perry-class guided missile frigate
CVN	Aircraft carrier
CG	Ticonderoga-class Aegis cruiser
DD1	Spruance-class destroyer
DD2	Spruance-class destroyer
LA	Large deck amphibious platform (LHA)
LP	Amphibious platform (LPD)
LH	Large deck amphibious platform (LHD)
LC1	Landing craft (LCAC)
LC2	Landing craft (LCAC)
TG	Task group (MEU)
BAS	Airfield (Sigonella)

C. AWK Programs

A suite of programs written in the UNIX-based utility AWK are provided for further analysis of the A2C2 Initial Experiment. They also serve as a basis for future analysis of any experiments that use DDD-III. Amplifying instructions are also provided.

1. AWK Programs and Instructions

a. Action_Sort

This program is used on the log files to extract all of the records associated with a specific action. The specific player action code is entered in the program between the quotes on the fourth line. The output contains all of the records that contain the specific action code in the second field (see LOG FILE PROTOCOLS above). The pound sign (#) is used to indicate comments in the program. Those lines are not executed.

```
# Action_Sort Program
#
BEGIN { RS = ORS = "*" }
$2 == "2010" { print }
#
```

The BEGIN statement in the third line indicates that prior to searching the file, AWK should perform the action in { }. The “RS = ORS = “*” ” statement tells AWK to set the record separator (RS) and output record separator (ORS) defaults to an asterisk (*) (See LOG FILE PROTOCOLS). The “\$2 == “2010” ” statement tells AWK to look in field 2 of a record for the action code “2010”. The statement “{print}” tells AWK to print the record(s) that match the input conditions to the specified output device (screen (default), printer, or file).

To execute the program, it must first be written in a text editor and saved. Then, in a UNIX command window, type “awk -f filename1 filename2”. “Filename1” is the name of the AWK program and “filename2” is the name of the file that you want to

analyze. This will print the results to the screen. If it is desired to print to a file, the command is “awk -f filename1 finename2 > output_filename”. If output is printed to a file for further analysis, open the output file in a text editor and insert an asterisk as the first character of the file.

b. Task_ID

This program is intended for use on a file that has already been sorted by “Action_Sort” according to the “ATTACKING” code (2010). The output of this file contains all of the records that contain the Task_ID numbers specified in parentheses. The syntax of this program is the same as “Action_Sort”.

```
# "Task_ID" Sort Program
#
BEGIN {RS = ORS = "*"}
$27 == "271" || $27 == "272" {print}
#
```

The “||” is an “OR” operator which allows for more than one Task_ID to be searched for in a single execution. The execution commands for this program are the same as for “Action_Sort”.

c. idget

This program is intended for use on a file that has already been sorted by Task_ID. The output of this file contains the Platform_ID numbers of the platforms used to prosecute the attacks on the Task_IDs specified in “Task_ID”. This output is used as input for “Asset_Transfer”. The execution commands are the same as previous programs, however, it is recommended that the output be sent to the screen for immediate use.

```
# Platform_ID Identification Program
#
BEGIN {RS = "*"}
  { print $4 | "sort -t'\n' -u" }
#
```

This program looks in the fourth field (\$4), prints the value, and then sorts the value (“sort -t'\n' ”) and then discards duplicates (-u).

d. Asset_Transfer

This program is intended for use on a file that has already been sorted by “Action_Sort” according to the “ASSET_TRANSFER” code (2009). Asset_Transfer takes as its arguments the Platform_ID number(s) from “idget”. These number(s) are entered between the parentheses. The output of the file is all of the records of asset (or platform) transfers.

```
# "Asset_Transfer" Sort Program
#
BEGIN {RS = ORS = "*"}
  $4 == "110" || $4 == "115" {print}
#
```

The “OR” operator is present in case there was more than one platform used to prosecute attacks against a task(s). The recommended execution command is “awk -f filename1 filename2 >> output_filename”. The “>>” command appends the output of this file to the original output file. This is done to accumulate all of the output into one file that can be used to determine the mission thread for specific actions.

e. Info_Task_ID

This program is intended for use on a file that has been sorted by “Action_Sort” according to the “INFO_TRANSFER” code (2013). The argument(s) for

this program are the Task_ID(s) used in "Task_ID". Its output is a record of all information transfers that occurred with respect to the specified Task_ID(s).

```
# "Info_Task_ID" Sort Program
#
BEGIN {RS = ORS = "*"}
  $6 == "271" || $6 == "272" {print}
#
```

The recommended execution command is the same as that for "Asset_Transfer".

f. Comms_Task_ID

This program is intended for use on a file that has been sorted by "Action_Sort" according to the "SEND_MESSAGE" code (2014). The argument(s) for this program are the Task_ID(s) used in "Task_ID". Its output is a record of all communications that occurred with respect to the specified Task_ID(s).

```
# "Comms_Task_ID" Sort Program
#
BEGIN {RS = ORS = "*"}
  $14 == "A?-271" || $14 == "A?-272" || $14 == "AHH-271" || $14 == "AHH-272"
{print}
#
```

The recommended execution command is the same as that for "Asset_Transfer".

g. Comms_Platform_ID

This program is intended for use on a file that has been sorted by "Action_Sort" according to the "SEND_MESSAGE" code (2014). The argument(s) for this program are the alphabetic platform class and type information obtained from the scenario generator files and listed above (e.g. H MV), and the Platform_ID(s) used in "Asset_Transfer", prefixed with the the alphabetic code and a dash (e.g. H MV-118).

Each of these arguments must be set in single quotations (e.g. 'HNV'). Its output is a record of all communications that occurred with respect to the specified Platform_ID(s).

```
# "Comms_Platform_ID" Sort Program
#
BEGIN {RS = ORS = "*"}
  $12 == "SD" || $12 == "SD-100" || $12 == "SAM" || $12 == "SD-110" || $12 ==
  "SD-115" || $12 == "SAM-100" || $12 == "SAM-110" || $12 == "SAM-115" {print}
#
```

The recommended execution command is the same as that for "Asset_Transfer".

h. Assign_Task

This program is intended for use on a file that has been sorted by "Action_Sort" according to the "ASSIGN_TASK" code (2017). The argument(s) for this program are the Task_ID(s) used in "Task_ID". Its output is a record of all communications that occurred with respect to the specified Task_ID(s).

```
# Assign_Task Program
#
BEGIN {RS = ORS = "*"}
  $4 == "256" || $4 == "257" || $4 == "271" || $4 == "272" || $4 == "296" || $4 ==
  "297" || $4 == "307" || $4 == "308" || $4 == "320" || $4 == "321" || $4 == "335" || $4 =
  "336" {print}
#
```

The recommended execution command is the same as that for "Asset_Transfer". This same program can be used on files sorted by the "TASK_PENETRATION" code (2018).

D. SUMMARY

This tutorial was designed to be used on the DDD-III log files from the A2C2 Initial Experiment. Though it was designed for this specific task, the methodology presented in the thesis and the above programs can be used as a baseline for further research using any DDD variant. The necessary information should be obtained from the

programmer as soon as the final scenario generator files are written. It is recommended that the analyst work in close concert with the programmer to decrease the slope of the learning curve required to analyze the log files.

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